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ASIATIC SOCIETY OF BENGAL,

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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish if such communications shall be long intermitted; and it will die away, if they shall entirely cease."—
SIR WM. JONES.

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JOURNAL

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ASIATIC SOCIETY.

No. IV. 1858.

A few remarks on the first fasciculus of Professor Wilson's *Sanskrit Dictionary, as "extended and improved"* by Dr. Goldstucker,—by Fitz-Edward Hall, M. A.

The first eighty pages of the work in question—all of it that we have yet seen—correspond to a little more than twenty-nine pages of Professor Wilson's dictionary in its second impression. No small portion, indeed, of this increase of matter is only apparent, and due to a more sumptuous style of typography; and yet Dr. Goldstücker's own additions are by no means inconsiderable. The literature of the Veda, and of Sanskrit law, medicine, philosophy, and rhetoric will doubtless be rendered much easier of acquisition than formerly, if the editor carries his design to the end on the same plan with that of its commencement. The subject of etymology has, also, at last received the attention of a scholar familiar with the terminology of the native grammarians; and, if only as a necessary consequence, the arrangement of the significations of homonymes is now noticeably less bewildering than it was of old. In general, there is scarcely a page of the new revision that does not testify to extensive research and to great and conscientious labour.

On the other hand, Dr. Goldstücker's scheme appears to us to be, in some respects, susceptible of amendment. Why, for instance, the constantly recurring compounds, which even the merest tyro can resolve for himself, when he meets them? The vocabulary of the Sanskrit has, for artificial copiousness, a very imperfect analogue,

in that of the Greek. In the first place, as to the verbal elements of the latter language, the line has been clearly defined which demarcates what is classical, or legitimately developed, from what is inadmissible; chronology being, for the most part, the criterion. Experience, moreover, has shown it to be practicable to embrace, within a reasonable compass, all the complex terms that occur in extant Greek authors: and the accession of such terms, from works likely still to be discovered, is contemplated without apprehension. But the case is found to be very different indeed, when we turn to the Sanskrit. For who, here, is not classical, or, at least, is not of weight for his words? The next century may solve the problem; but our own—for which Dr. Goldstücker is working—will not. We propose this consideration with a definite object. Let it be presumed that, by and bye, accidental critics will concur in distinguishing certain compositions, say to the number of two hundred, as possessed of the characteristic of classicality. Yet, even in these circumstances, we should scarcely expect a lexicographer, after well weighing his functions, to go about to accumulate all the words occurring in them, of the sort to which we refer. Still more unfeasible, and equally supererogatory, would it be, if the entire body of Sanskrit literature were ever thought deserving of lexical treatment, to attempt a complete collection, from it, of vocables of this description. No twenty folios might avail to exhaust them. The assertion is not to be questioned, that the ancient Hindus invented compounds at will; and such, to this day, is the practice of the pandits. No such terms, to our thinking, should ever have place in a dictionary, unless they are technicalities, or unless their acceptation is not at once to be gathered from their factors; the knowledge of one or two facts of Hinduism, and a moderate acquaintance with the grammar, always being postulated in the inspector.*

* Dr. Trench has spoken boldly, but wisely, on the subject of bettering our English Dictionaries; and one most important respect in which they are capable of melioration is, as he urges, in the way of retrenchment. On the point of the claim of compounds to be inserted in our dictionaries, he holds the following language: "When words have been brought into close connexion with one another, not in the choice or caprice of one writer, and on a single occasion or

We will illustrate our meauing by a single example, and one which we have not gone far to seek. In commou Sanskrit there are some thirty current words for 'earth,' ten for 'man,' four for 'master' or 'lord,' and six verbal suffixes for 'holder,' 'protector,' or 'enjoyer.'* Now, in our own limited reading we have, with only a few exceptions, met with a majority of the words for 'master' and suffixes for 'holder' or 'enjoyer' annexed to each of the words for 'earth;' and so of the synonymes for 'man,' followed by the synonymes for 'lord:' the result being always the same, the equivalent of 'king.' Aud, if any oue of those three hundred and forty allowable regal composites may claim to be represented in a lexicon, why may not all? On the principle with which Dr. Goldstücker has set out, we are to have all, iu process of time; on the condition, possibly, that, in the course of his studies, he obtains proof of their having actually been used. The same remark applies to the words for 'sun,' 'moon,' 'Bráhman,' &c. &c. Three lines of explanation in the preface would economize many times three pages of quite gratuitous symbols. Our fear of seeing the new edition of Professor Wilson's dictionary overloaded with superfluities has only too good ground, if we may augur from the sample before us. Out of the twenty articles which make up the first page—and it is not a full page—there are six which, in our judgmeut, have no right there: अक्षणिन्, अंशकरण, अंशभाज्, अंशहर, अंशहारिन्, अंशुजाल; and so onward everywhere. The particular specimens just given were, we are aware, in Dr. Goldstücker's original: but, even though he may not have been permitted to strike them out, yet we suppose he was under no compulsion to add, iudefinitely, new ones of the same stamp. Hundreds of words beginning with the negative

two or three occasions, but by the consenting use of many, appear in constant alliance, being in this their recognised juxta-position to all intents and purposes a single word, they may then claim their admission of right." *On some Deficiencies in our English Dictionaries*, p. 50. Why not exclude, as a rule, all that we do not naturally write without a hyphen?

* We might have gone very much further. There are, in post-vaidika Sanskrit, upwards of sixty words for 'earth.' See Professor Williams's English and Sanskrit Dictionary.

prefix अ or अन्, and with the intensive particle अति, could, without the slightest loss, also be dispensed with. If अतिप्रौढयौवन have a title to presentment, why should any combination whatever of a particle, an adjective, and a substantive, into an epithet, be extruded, when it shews itself?

Nor have we yet done. The proper names of heroic and mythical personages mentioned up and down the *Mahábhárata*, the *Rámáyaṇa*, the Puráṇas, &c., can hardly be less than a hundred thousand. Yet none of them is to be neglected by Dr. Goldstücker, if he adheres to the method, on which he has begun, of pouring a biographical index into a dictionary proper. Half a quarto page and more is assigned to Angiras, two-thirds of a page to Atri, one-third of a page to Agasti, and as much to Agni. Descending to the limits of sober history, the kings of Cashmere, their wives, their daughters, their chamberlains, and their generals, have, each, a niche. Even Adwaitánanda is remembered: "one of the founders of the Vaishṇava sect in Bengal. He lived about the end of the fifteenth century." Nor are the shadowy actors in avowed fictions reckoned unworthy of commemoration; such as Anangasená, "the proper name of a courtesan in a drama." That the cloak of indefiniteness is thus thrown about this frail beauty may, by possibility, not be a squandering of generous delicacy: but, at the same time, it is pertinent to enquire why she should here be obtruded on us, even for half-acquaintance. The *Vásavadattá* of Subandhu introduces us, in one place, to a whole novenary of nymphs, and, in another, to a drawing-room of as many as two and thirty; all of them, on charitable presumption, quite as it was expected they should be, in spite of the somewhat warm tone of their conversation. Though the alphabetical leader of them, Anangalekhá, has, we perceive, eluded Dr. Goldstücker's attentions, he should thank us for intimating to him that just two score still await the courtesy which he cannot now, with any more grace than consistency, deny them. Again, in the *Harsha-charita* we read of thirty-eight lads and lasses —their names all spelled out at length—who used to assist Báṇa when he played at royalty. And why, by parity of reason, should Charaṇákaranka. Kalákaláda, Haraṇika, and the rest be forgotten? The *S'ankara-dig-vijaya* likewise contains some hundreds of proper

names; and it is no sufficient reason to reject them, that they belonged mainly to misbelievers. To say nothing so special of the other divinities, the spots held sacred to S'iva alone are all but innumerable; and so are the phalli which bear separate designations. Once more, the eighty or ninety *Sahasra-námas* of themselves furnish as many thousand accredited epithets of gods and goddesses. Why should a single one of them be slighted?

Looking still more narrowly into Dr. Goldstücker's undertaking, it appears, in fact, to wear the pretensions of a veritable encyclopædia; bibliography and geography, no less than biography, constituting a component part of his comprehensive enterprise.* Upanishads, sections of the Veda, apocryphal hymns, the *Atri-sanhitá*, the *Adbhuta-rámáyaṇa*, and the *Anarghya-rághava* of Murári, all have articles. As the number of distinct Sanskrit works in existence is, probably, not less than ten thousand, a mere list of them, be it ever so meagre of details, would alone take up a volume.

It must be obvious, by this time, that the system on which the dictionary of Professor Wilson is undergoing reconstruction involves, in copious proportion, many specialties that are altogether misplaced. The new edition, which aiming at much more than is attempted in any rationally digested lexicon of Latin or Greek, yet falls short of their standard in, at all events, one most essential particular. We mean, in its citing no authorities.† On countless

* Our industrious Teuton appears, in truth, to have copied, however unconsciously, the method of our English dictionaries, as they were loosely styled, which preceded that of Johnson. These disorderly repertories, Dr. Trench describes as being "not dictionaries of words only, but of persons, places, things: they are gazetteers, mythologies, scientific encyclopædias, and a hundred things more; all, of course, most imperfectly, even according to the standard of knowledge of their own time, and with a selection utterly capricious of what they put in, and what they leave out." *On some Deficiencies*, &c., p. 45.

† The learned and judicious critic already twice cited speaks for all the world, equally as for himself,—the sciolists who cling to the shade of Dr. Webster excepted,—when he says: "To me there is no difference between a word absent from a dictionary, and a word there, but unsustained by an authority. Even if Webster's *Dictionary* were in other respects a better book, the almost total absence of illustrative quotations would deprive it of all value in my eyes." *On some Deficiencies*, &c., p. 7, foot-note.

occasions have we gone back from Professor Wilson's second edition, which likewise gives none, to the first, where they are often noted, and have thus obtained a clue by which to satisfy our misgivings. And what student of the Sanskrit does not do so constantly? Who, above all in the infancy of our knowledge of the Sanskrit, will not insist upon some better warrant for what he accepts, than a simple implied *dixit magister?* In the present instance, a want of space can scarcely be received as an apology for the defect here indicated; for space in all abundance might have been secured by sacrificing but a small fraction of what we have designated as intrusive. The present observations are written without an opportunity of inspecting the thesaurus of Messrs. Böhtlingk and Roth. It is to be hoped that the procedure adopted in it, as concerns the adducing of authorities, is more scholastic than that of Dr. Goldstücker. As for the English of the sheets before us, considering that they were printed in Germany, its correctness is highly commendable. Nor are such errors as meet the eye of a kind to occasion perplexity. The principal that we have noticed are "a pumpkin born out of season," a woman who "has born him children," "hypothenuse," "neutre," "filtre," "shrewed," "ennuque," and "different than." The system of romanization is not uniform throughout: for example, "*dwandwa*" and "*dvandva*," "*ahankára*" and "*ahamkára*," "*manvantara*," and "*sarwakarman*." "अजपाल" is a mistake* for अजापाल,'

It is high time, on other grounds, that the superficial but pretentious work here glanced at, should receive a thorough exposure at the hands of some such man as Dr. Trench. Before learning English himself, Dr. Webster undertook to teach it to others. Here is a sample. "*Feel* this piece of silk, or *feel of* it." We could easily bring forward a hundred other proofs of ignorance as gross as this. A Yankeeism, however, was, to Dr. Webster, even when he knew it for such, no solecism. Are Englishman who confide in his awards generally aware of this fact?

* एकदा वत्सरे प्राप्ते अजापालो नृपात्मजः।
अयोध्याधिपतिः श्रीमान् शक्रतुल्यपराक्रमः॥
अष्टोत्तरशतव्याधीनजाः कृत्वा ररक्ष च।
सपादलक्षं जीवन्ति प्रजास्तस्मिन् महीपतौ॥

Revá-máhátmya, 25th chapter.

This seems to mean that Ajápála, king of Ayodhyá, being afflicted with one hundred and eight bodily ailments, relieved himself by turning them into she-

and "अधारोपन" for "अध्यारोपण." We should, farther, write 'Bṛihaspati' for "Vṛihaspati," 'अंशुबाण' for "अंशुवाण" 'अचोव' for "अचोव," 'अग्निबाण' for "अग्निवाण," 'अग्निबाङ' for "अग्निवाङ" and "अग्निबीज' for "अग्निवीज," The neuter "Brahma" occurs written "Brahman" also.

How far Dr. Goldstücker has consulted the native vocabularies is left pretty much to conjecture. Many compilations of this kind, unknown to Professor Wilson, could be procured, in this country, without difficulty; and probably not one of them, however insignificant or unoriginal, would be without value. Such as have fallen, as it were spontaneously, in the way of the writer of these lines, are here enumerated.

1.—The *Amara-kos'a-vivṛiti*, by Lingaya Vangala, commonly called Lingam Bhaṭṭa. The author is said to have lived in the south. A commentary on Amara.

2.—The *Budha-manohara*, by Mahádeva, surnamed the Vedántin. Another commentary on the *Amara-kos'a*. Imperfect, so far as seen.

3.—The *Náma-ratnákara*, by Koï Deva.

4.—The *Náma-sangraha-málá*, by Appayya Díkshita—not Árya Díkshita.

5.—The *S'abda-prakás'a*, digested at the instance of some Muhammadan of note, whom the author styles "Khána Nṛipati." It is a dictionary of homonymes. The only MS. which we know of is defective. It was copied in the *Samvat* year 1575.

6.—The *S'abda-prabheda*, by Mahes'wara. This is a work of small extent, on words variously written, and is in verse. It is not to be confounded with a section of like character in the *Vis'wa-prakás'a*, which likewise has a Mahes'wara for its author.

7.—The *Nánártha-kos'a*, by S'ás'wata.

8.—The *Nánártha-ratna-tilaka*, perhaps by Mahípa. It was composed in the year 1430, of an unspecified era.

9.—The *Lakshmí-nivásábhidhána*, by S'ivaráma Tripáṭhin, the scho-

goats, which he nourished. Whatever the absurdity of the story, it has its worth, to the maker of a mythological dictionary, in determining the correctness of a long syllable as against a short one. That the text is not depraved is presumed.

liast on the *Vásavadattá.* This is a collection of the *Uṇádi* derivatives, with definitions. It is said to have elicited a volume of annotations.

10.—The *Gaṇa-nighaṇṭu,* by Chandrachandana.

11.—The *Madana-vinoda-nighaṇṭu,* by Madana Pála. It was written before the middle of the fifteeuth century. Like the last, it is concerned with the materia medica.

12.—The *S'iva-prakás'a,* by S'ivadatta, son of Karpuríya Chaturbhuja. The author annotates his own work, which bears date in the year 1599 of S'aliváhana. In subject, it is like the last.

13.—The *Dravya-ratnákara-nighaṇṭu,* possibly by an anonymous author. It cites the *S'iva-prakás'a.* This, too, is medical. The sole MS. which has been consulted is incomplete.

14.—The *Rája-vallabha,* by Náráyaṇadása. It treats of officinal substances. It has been printed at least twice, with a Bengálí translation.

Public Inscriptions at Lahore.—By Henry Cope, *Esq.*

Hureeke viá Umritsur, 22nd March, 1858.

The Secretary of the Asiatic Society, Calcutta.

Sir,—Looking over some of my papers, I found copies of all the inscriptions in existence on the public buildings of Lahore, which had been carefully taken under my directions during my residence there, aud as I believe they have uot been published, and it is desirable to preserve all available records of the kind, I do myself the honor to forward them for publication in the Journal of your Society, if you think them worthy of the houor.

I have added a brief memoir of the several buildings from which they are taken.

I have the honor to be, Sir,

Your Obedient Servant,

Henry Cope.

No. 1.—Motee Mundur.

(Persian Inscription.)

Translation.—Completed in the twelfth year of the reign of the emperor, (the shadow of God, a Solomon in equity) Noor-ood-deen, Jehángeer Pádsháh, son of Jelal-ood-deen Akbar Pádsháh Gházee, A. H. 1020, under the superintendence of the least of his lowest slaves, Soondur Khan.

The palace, or fort of Lahore, was commenced by the magnificent Akbar, and many elegant fragments of the style, peculiar to his age, were to be seen before the barbarous improvements of an executive engineer demolished or defaced what the Sikhs had left when they became masters of Lahore. The design of Akbar was carried out by his son, and we may reasonably consider the date of the completion of the Motee Mundur, formerly Motee Musjeed, as the date of the completion of the palace. It corresponds with the year of our Lord 1614. Jehángeer made Lahore his capital for many years. He died in the Beembur hills; his remains were conveyed by Noor Jehan to Lahore, opposite to which at Shadera on the right bank of the Ravee, she raised the splendid mausoleum that still attracts numerous admiring visitors. (I have not given the inscription on Jehángeer's tomb, as it is recorded in the Asiatic Register by an English officer, name not given, who visited Lahore in 1808, and wrote a most interesting account of the town and of the Court of Runjeet Singh. He travelled from Hurdwar in the train of one of the Maharaja's wives).

The Motee Mundur was the "private chapel" of the palace, and used as such, till Runjeet Singh began to grow rich, when he selected it as a suitable place for the storing of his wealth in gold, silver and jewels. It is believed at one time to have contained treasure to the amount of two millions sterling. It is small, has been, since it was converted into a Treasury, surrounded by a strong wall, and has continued to do the duty imposed on it by the Sikh sovereign, ever since annexation. It boasts of the most beautifully chaste marble dome on any Muhammedan building I have ever seen, deeply scored with the marks of balls fired during the Sikh troubles, after the Máhárájah's death, from the Minars of the imperial mosque.

No. 2.—Hatipaur Gate of the Palace.

(Persian Inscription.)

Translation.—The king, a Jumsheed in dignity, a Solomon in reputation, whose court is in the seventh heaven, whose noble standard waves above the region of the sun, a second Sahib Kiran, "Sháh Jehán," who in justice and liberality surpasses Nousheerwán and Fureedoon,

Ordered a (Royal?) tower to be erected, which in height should be beyond measurement and conception, like unto the highest heaven.

In brightness, loftiness, and excellence such a tower never has been, and never will be seen under the sky. After its completion his sincere slave and pious disciple Abdool-Kareem, comprised the year of its erection in the following couplet:—

Like the empire of this all-powerful monarch who has an army equal to that of Jumsheed,

May this propitious and lofty tower ever remain free from injury.

(The date thus illuminated is the 1041st year of the Hijra, corresponding with A. D. 1631).

It would appear, from the above, that Sháh Jehán added a tower at the north-west angle of the palace, which, unless the "sincere slave" wrote in an unusually hyperbolic style even for a servant of the "king of kings" has entirely disappeared. The inscription, may, however, allude to the Sheesh Muhul with which the gate communicated by a tramp constructed for the use of the elephants who conveyed the ladies of the Harem to and from their apartments. The Sheesh Muhul is in the Sumun Bourj (Jasmine tower) certainly the most conspicuous part of the palace, and its decorations partake more of the style prevalent in the time of Sháh Jehán than those introduced by Akbar or Jehángeer.

No. 3.—The Imperial or Badshahee Mosque.

(Persian Inscription.)

Translation.—This mosque of Ab-ool-zuffur Mohee-ood-deen Mahomed Alumgeer Pádsháh, was finished in the year of the Hijra 1084, under the superintendence of the humblest of his slaves Fidáee Kháu, Kokah.

Tradition ascribes a much older date to this edifice, built by the emperor Aurungzeb in A. D. 1673, during one of the few visits

he paid the Punjab. It differs from edifices of the kind by having four minars of lofty proportions at each corner of the spacious quadrangle, at the western extremity of which it stands, instead of two on the northern and southern walls, as in the Jumma Musjid of Delhi which it otherwise resembles. The gateway on the eastern side of the quadrangle now stands out isolated in handsome relief at the top of a noble flight of steps, facing the western entrance of the fort; prudential motives having removed the cloistering on either side so as to leave the terrace open to sight from the fort walls. The mosque served, for upwards of forty and odd years, as a magazine both to Runjeet Singh and the British Government, but the ordnance stores have, within the last three years, been removed into the fort, and the mosque restored to the Musalmáns of Lahore. Their gratitude might have assumed a painfully practical shape in 1857, had less vigorous councils prevailed than those which, on the 13th May in that year, saved the Punjab from an insurrection and a mutiny.

No. 4.—The Mosque of Wuzeer Khan.

(Persian Inscription.)

Translation.—Completed during the reign of Uboo'l-Moozuffur the second, Sahibi Kiran Sháh Jeháu Bádsháh Gházee.

This sacred temple was founded by his devoted follower and esteemed disciple and old servant Wuzeer Khau, 1044, Hijra, A. D. 1634.

This is one of the most elegant buildings of Lahore, ornamented throughout in that beautiful tesselated style which the architects of those days borrowed from the Chinese (workmen were brought across the Himalaya to give it the true "Porcelain" character) and which the men of the present day cannot even imitate, much less equal. It has suffered very little at the hands of the followers of Nanuk, whose intolerance should have taught patience at least to the Mahomedan, though they desecrated its courts, and its pools by killing swine and sprinkling the walls with their blood.

No. 5.—A small tesselated Mosque near the Moochee Gate.

(Persian Inscription.)

Translation.—Zuhoor Bukhsh laid the foundation of this mosque, Mahomed Sálih completed it, A. H. 1072, (A. D. 1661).

Neither the names of Zuhoor Bukhsh or Mahomed Sálih are known to fame, nor recorded in history. The mosque is known as the "Cheeneeán-walee Musjeed."

No. 6.—The Golden or Tiláee Mosque.

(Persian Inscription.)

Translation.—Founder of this mosque Nujwaree Khán. *(No date).*

This building has been made much more of by travellers than it deserves. It is small, advantageously situated on a high terrace at the bifurcation of two streets, but so surrounded by high houses that it can only be seen from a distance. Attached to it is a curious baolee of great depth, whence the best water in the town is procurable.

Henry Cope.

Hurecke viâ Umritsur, 22nd March, 1858.

No. 1.—Motee Mundur.

تاریخ بر دروازهٔ موتي مذدر واقعه قلعهٔ لاهور

سال دوازدهم جلوس پیش بندگان حضرت شاهنشاه ظل الله سلیمان جاه عدالت پناه نورالدین جهانگیر بادشاه ابن جلال الدین اکبر بادشاه غازي یکهزار بیست سنه ۱۰۲۰ هجري باهتمام کمترین غلامان کهترین سندرخان صورت اتمام یافت

No. 2.—Inscription on Hatipaur gate of the Palace.

تاریخ بردروازه هاتهي پور

شاه جم‌جاه سلیمان‌قدر کیوان بارگاه کزسپهر مهر برتر برده رایات جلال
ثاني صاحب‌قران شاه‌جهان کزعدل‌وجود نیستش نوشیروان مانندو افریدون همال
شاه برجي حکم کرد احداث کز فرط علو هست بیرون همچوعرش اعظم ازوهم وخیال
درصفا و رفعت و لطف برجي چنین* ازحصارچرخ ننموده است وننماید جمال
بنده یکدل مرید معتقد عبدالکریم بعد اتمام عمارت یافت این تاریخ سال
دایما چون دولت این بادشاه‌جم سپاه این همایون برج عالي‌باد ازآفت بے زوال

سنه هجري ۱۰۴۱

No. 3.—Inscription on the Imperial Mosque.

تاریخ بر دروازه مسجد بادشاهي

لا اله الا الله محمد رسول الله

مسجد ابوالظفرمحی الدین‌محمد عالمگیر بادشاه غازي سنه یکهزار هشتاد و چهار ۱۰۸۴ هجري باهتمام کمترین خانه زادان فدایخان کوکه اتمام یافت

No. 4.—Wuzeer Khan's Mosque.

تاریخ مسجد وزیرخان

* The metre of this line is defective,—a word is wanting before برجي —Eds.

در عهد ابو المظفرصاحب قران ثاني شاه جهان بادشاه غازي باني اتمام يافت
بيت الله ثاني فدوي باخلاص مريد خاص الخاص قديم الخدمت وزيرخان
سنه ۱۰۴۴ هجري

No. 5.—A small Mosque near Moochee Durwaza.

تاريخ مسجد چينيان والي متصل موچي دروازه
باني مسجد ظهور بخش بسعي محمد صالح صورت اتمام يافت سنه ۱۰۷۲ هجري

No. 6.—Soneree Musjeed.

مسجد طلائي
باني مسجد بخواري خان سنه ۱۱۶۳ هجري

Notes on the distribution of some of the land and freshwater shells of India: Part II.—By W. Theobald, Junr.

Birmah and the Tenasserim Provinces.

(Continued from page 254).

Freshwater Shells.

Order. Prosobranchiata.

Family. Melaniadæ.

Melania. Lam.

1. M. variabilis, Bens.—Birmah and Tenasserim provinces, passim. A very large and fine variety occurs in the Tenasserim river and is eaten by the Karens. A decollated specimen of *four whirls* measures 2.40 by 1.05.

A sharp pointed smooth variety is met with at Noung-ben-ziek, on the Irawadi near Prome which measures 2.50 by 0.86, number of whirls 10.

2. M. lirata, B.—Birmah and Tenasserim provinces, passim. This shell usually occurs of a small size in the Tenasserim valley. A very large variety is found in Pegu prominently studded with tubercles, length about 2.25, but I have no specimen to refer to Usual size of the common variety 0.90 by 0.45.

3. M. tuberculata, Mull.—Small and poor. A specimen from Thaiet-mio measures 0.90 0.26. A Bombay specimen 1.40 0.41.

4. M. spinulosa, B.—Tenasserim river. Very small and rare.

5. M. Jugicostis,* B.—Tenasserim river, rare. A doubtful species.

Paludomus.

6. P. Regulata,* B.—Common in marshy places and streams near Prome and Thaiet-mio. This is a sharp pointed shell, having little resemblance to the typical species of the genus.

7. P. labiosa,* B.—A small species tolerably abundant in the Tenasserim valley in running streams and the head waters of Tavoy Province.

8. P. ornata,* B.—Prome and the neighbourhood. Not a plentiful species.

Family, LITORINIDÆ.

Stenothyra. B.

9. S. Monilifera, B.—Mergui. In wet ditches.

Assiminea. Leach.

10. A. Francesiæ, Gray.—Maulmein, common.

Family. PALUDINIDÆ.

Paludina.

11. P. Bengalensis, Lam. Prome. Rangoon. Very common, and fine. A dark ferruginous stained variety is not rare at Rangoon. The Birmese shells, however, do not equal *some* Bengal specimens. A large specimen measuring 1.44 by 1.05, whilst a specimen from Benares measures 2.05 by 1.40.

12. P. Crassa, Hutton.—Thaiet-mio, rare and small.

13. P. Melanostoma.—Henzada. Rangoon. Common.

Bithinia. Gray.

14. B. Cerameopoma, B.—Ava, (procured by Mr. Oldham). Maulmein.

15. B. pulchella (?)—Maulmein.

Amphellaria. Lam.

16. A. Globosa, Swain.—Prome, very common. Maulmein. Tavoy.

Family. NERITIDÆ.

Neritina. Lam.

17. N. Humeralis,* B.—Salween river, within the tideway—of the type of N. reticularis.

NOTE.—New species described by Benson marked thus. *

18. N. Cryptospira,* B. Tenasserim river. This little species occurs abundantly on stones in rapids just above the tideway.

19. N. Fuliginosa,* n. s. mihi.—Testâ neritinæformi, subglobosâ, spirâ minimâ; colore luteo-flavescente rubro reticulatâ; intus flavescente-pallida; aliquando cærulescente; non raro fasciis duobus cincta in aperturâ facilius visis. Epidermide plerumque nigro colore, extraneo fucato; semipolita, operculo pallide aurantiaco, margine anteriore rubro. Longitudinis 0.40. Habitat in regno Burmanorum proper urbem Amrapoora sive Ava dictam. Teste, T. Oldham.

Order. PULMONIFERA.

Family. LIMNÆIDÆ.

Limnœa. Lam.

20. L. Succineus, Desh.—Prome, common.

Planorbis. Müll.

21. P. Coromandelicus, Fab.—Prome and Rangoon, &c. Common but not large.

Class. CONCHIFERA.

Family. ARCADÆ.

Scaphula. B.

22. S. Pinna,* B.—Tenasserim river within the tideway but in freshwater. This species appears to have been previously noticed and recorded as a Dreinnia in Mason's work on the Birmese Fauna, till I forwarded specimens to Mr. Benson, who described the species in the annals of Natural History for 1856. It adheres firmly by means of a short byssus to porous rocks (Laterite) in the cavities of which it nestles.

Family. UNIONIDÆ.

Unio. Retr.

23. U. cæruleus, Len.—Thaiet-mio in small streams and feeders of the Irawadi, not large or common.

24. U. crispisulcatus,* B.—Very common in small streams near Thaiet-mio, where it is eaten by the Birmese, 1.96—1.23.

25. U. Pugio,* B. Irawadi river near Ava. Procured by Mr. Oldham.

26. U. marginalis, Lam. ?—An allied species, if not a variety of this shell occurs near Prome, 4.30—2.00.

27. U. Parma,* B.—Common in the Irawadi and Tenasserim rivers, 2.56—1.90.

28. U. scutum,* B.—Common in the Tenasserim river, 3.90—2.05.

Family. Cycladidæ.

Corbicula. Muhlf.

29. C. Arata,* B.—Common in the Tenasserim river.

Family. Solenidæ.

Novaculina. Benson.

30. N. Gangetica, B.—Tenasserim river. This shell occurs in great quantities in mud banks within the tideway, but in freshwater, and is collected for food. My largest specimen measures 2.03 —0.88.

The above is very far from being a complete list of the fluviatile shells of the Provinces, but is given in default of a better. Many species of shells are probably yet to be found, and I have a single valve of a large species from the Bangong Nulla near Thaiet-mio, which stream deserves attention.

Mhow, June 9th, 1857.

Darjiling and the Khasia Hills.

In endeavouring to contribute (from personal observation as far as practicable) to our knowledge of the distribution of land shells in India, I think it will prove convenient, not to say necessary, to divide India proper into three distinct regions, viz. the Himalayan, the Central and the Southern region—neither do I think these divisions will be found to be mere arbitrary ones, for though a few species may be common to all and a still larger percentage to any two, yet each is distinguished by a sufficient number of characteristic forms, to render such an arrangement not one of mere convenience, but essentially a natural one. In like manner Ceylon and the Tenasserim Provinces form two very natural divisions, and though I could wish that this subject had been taken up by one having greater experience than myself, yet, as a beginning, I venture to offer in the present paper, the results of my observations within the area which has fallen beneath my examination.

The Himalayan region has only been partly examined by me, and I shall therefore confine myself to its eastern portion, availing myself to some extent of the observations of my colleague Mr. W. Blanford, who obtained, when at Darjiling, several shells which had escaped my notice.

The central region commencing in the plains below the lower slopes of the hills, embraces the entire area outside the hills, drained by the Ganges and Máhánádi to the east, the Nurbudda and Taptee to the west, and the Indus and its tributaries to the north-west, a large and important area, but of a richness by no means commensurate with its extent.

Of the southern region, I know nothing personally, but the known shells of that quarter sufficiently support its claim to rank as an independent division.

Khasia Hills.

The shells which are here given have mostly been named and described by Mr. Benson, save in one or two instances, though many names are still merely manuscript ones, but for practical purposes I think a mere description unaccompanied by a figure of the shell is of little use in discriminating between nearly allied forms, though required by custom to establish the currency of the name applied to a new species.

Cyclostomidæ.

Pterocyclos, Benson.

No. 1. *P. Hispidus*, Pearson.—Teria ghât at the foot of the hills on the road to Cherra. This handsome species is very abundant on rocks at the limestone quarries a little above Teria ghât, where a dwarf variety also occurs sparingly. Diameter over peristome, 1.20.

Ditto in dwarf, 0.70.

2. *P. Albersi*, Pf.—Teria ghât. A dwarf variety.

Cyclophorus, Montfort.

3. *C. Siamensis*, Sow.—Teria ghât (the quarries). This very handsome species occurs abundantly. The apex is generally imperfect, probably from falling among rocks; as it is a heavy shell.

4. *C. Pearsoni*, B.—Lacat. Very common. Varies in size from $\frac{1.90}{1.50}$ to $\frac{1.20}{0.90}$

5. *C. Zebrinus*, B.—Nanclai Poonji on the northern water-shed of the Khasia hills, 92° 30′ east; 25° 15′ north. It is by no means an abundant species.

6.* *C. Tomotrema*, B. Teria ghât, rare. This shell is of the same type as the Birmese C. scissimargo.

7.* *C. Pinnulifer*, B.—Teria ghât. Not rare, varies from 0.60 to 0.30.

Leptopoma, Pfr.

8.* *L. Cybeus*, B.—Teria ghât, rare. Nanclai, rare. A thin shell of arboreal habits.

Alycæus, Gray.

9.* *A. Prosectus*, B.—Teria ghât; very common on rocks.

10.* *A. Hebes*, B.—Teria ghât, not rare.

Diplommatina, Benson.

11.* *D. Polypleuris*, B.—Nanclai. Not rare on rocks.

12.* *D. Diplocheilus*, B.—Teria ghât. A short species common on rocks.

Pupina, Vignard.

13. *P. Imbricifera*. B.—Teria ghât, rare. Found on rocks an decayed trees, but mostly on the latter. The operculum exhibits the spiral structure observable in Cataulus.

Hydrocena, Parryess.

14. *H. Sarrita*, B.—Teria ghât. Cherra, Nanclai, common on rocks and amongst moss on trees.

Helicidæ.

Helix, L.

15. *H. Plectostoma*, B.—Teria ghât, very common, a large variety is found on limestone rocks, a smaller one on trees, juvenile shells of this species are remarkably hirsute.

16. *H. Serrula*, B.—Teria ghât. Common. A beautiful diaphanous species with sharply chisselled striæ causing a toothed periphery. Reeve's figure conveys a poor idea of the shell.

17. *H. Delibrata*, B.—Teria ghât. Very rare. This shell extends to Birmah and when fine has a hirsute epidermis.

18. *H. Tupeina*, B.—Teria ghât and along the foot of the hills. This shell chiefly affects Areca palm trees. It is very closely allied to the Birmese H. rotatoria.

19. *H. Climacterica*, B.—Teria ghât. Not rare. A dwarf variety occurs at Cherra.

20. *H. Cestus*, B.—Beneath Cherra. Not very common.

21. *H. Decussata*, B.—Teria ghât, rare.

22.* *H. Bascunda*, B.—Teria ghât, rare.

23.* *H. Galea*, B.—Teria ghât, rare.

24.* *H. Diplodon*, B.—Teria ghât, rare.

25.* *H. Castra*, B.—Teria ghât, rare. A Darjiling species.

26. *H. Planiuscula*, Hutton.—Cherra, rare.

27.* *H. Puellula*, B.—Teria ghât, rare.

28. *H. Oxytes*, B.—Nanclai poonji,* rather common among limestone rocks.

29.* *H. Castor*, n. s. mihi.—Testâ lenticulari, subdepressâ, vix umbilicata, acute carinata, confertim striatâ ferrugine—fuscâ anfractibus $5\frac{1}{2}$—6, magnitudinis 1.40—0.60. Habitat apud Nanclai, in montibus "Khasia" dictis.

This shell is not common, and I have only a barely adult specimen in good condition. It closely resembles H. oxytes which it accompanies, and from which it differs in its nearly closed umbilicus, and less ornate sculpture. The keel too is a trifle more acute and divides the body whorl in a symmetrical manner, from the shell not being so flattened down as H. oxytes. The shell is rather stout and the peristome probably thickened more or less.

30.* *H. Pollux*, n. s.—Testâ lenticulari, subdepressa vix umbilicata, acute carinata, tenue striatâ, translucente, colore stramineo, polita, peristomate acuto anpactibus $5\frac{1}{2}$—6, magnitudini 1.40—0.55. Habitat prope Teria ghât, ad pedem montium Khasia dictarum.

This shell is a very distinct species of the same form as the above, from which it differs in sculpture, want of solidity and colour. As far too as I can judge, its habits are arboreal, whilst the last species affects rocks in company with H. oxytes.

A few more helices occurred, of the naninoid type, but not in a satisfactory state for determination, but the hills below the Cherra plateau offer a tempting ground for future exploration as the richness of the few spots examined near Teria ghât proves.

* Poonji = village.

Streptaxis, Gray.

31.* *S. Theobaldi*, B.—Nanclai. Rare; amongst limestone rocks.

Vitrina, Draparnaud.

32. *V. Gigas*, B.—Near Teria ghât, but at some elevation, and also at Cherrapunji, length of a large shell 1.45.

33.* *V. Scutella*, B.—Teria ghât, rare.

34.* *V. Salius*, B.—Teria ghât, rare. The animal is a livid plumbeous colour, addicted to limestone rock in the sinous cavities of which it is chiefly to be found. It is very active and when touched, leaps several inches by rapidly twisting and whirling its tail in a very vermiform manner, indeed till this habit is known, it is not easy to secure in the rough places it mostly frequents.

Bulimus, Scopoli.

35.* *B. Polypleuris*, B.—A pretty little scalariform species, of which a single specimen only was found at Teria ghât.

36. *B. Sylhetieus*, B.—Not met with by me but included in Mr. Benson's list of Sylhet shells. It is found in the orange tree plantations at Lacat.

Achatina, Lamarck.

37.* *A. Pyramis*, B.—Teria ghât. Abundant under leaves and rubbish.

38. *A. Crassilabris*, B.—Teria ghât, rare.

39. *A. Cassiaca*, B.—Not found by me but included in Mr. Benson's list.

40. *A.* ——— sp. In too poor a state for description.

41. *A.* ——— sp. Ditto ditto.

Pupa, Lamarck.

42.* *P. Vara*, B.—Nanclai. Very rare.

43. *P. Plicidens*, B.—Cherra.—Very common on limestone rocks This is a Western Himalayan species.

Clausilia, Draparnaud.

44. *C. Loxostoma*, B.—Teria ghât. Very common, attached to rocks or stones. This shell differs much in appearance, being sometimes found entire and with clean epidermis, in others covered with green matter and decollated. This difference is the result of situation, those specimens taken from rotten trees and beneath the loose bark being perfect, whilst those attached in exposed situations

to rocks and boughs, being constantly moist for months together and generally with a drop of water pendent from the apex become decollated and covered with a green confervoid coat.

45.* *C. Ignota*, n. s.—Teria ghât. Rare, my two specimens at present in Mr. Benson's hands for description, so that the name here given is merely provisional. It is allied to C. cylindrica.

46. *C. Bacillun*, B.—Nanclai. Very rare. A new species but unfit for description, of the type of C. Insignis.

The freshwater shells may be dismissed in a few words, the most remarkable of them not being found by me. I allude to *Scapula celox*, which inhabits some of the streams in Sylhet.

Paludomus Stephanus, B. and *P. Conica*, Gray, occur at Teria ghât, the former in immense abundance.

Ampullaria also reaches a large size at Sylhet, one specimen of *A. Globosa*, measuring 3.45 by 3.18, the mouth being 2.41 by 1.40.

A very heavy Calcutta specimen being only 2.43 by 2.28, and the mouth 1.65 by 1.03.

A dwarf var. not rare about Calcutta, measures only 1.20 by 1.07.

Darjiling.

My present list of Darjiling shells, will, I regret to say, be found very meagre, owing to more than one cause over which I have no control. Since my visit to Darjiling, a large addition to previously known species, was made by Mr. W. Blanford, who has sent his unique specimens to England. Of the others, he has liberally furnished me with specimens, some of the most interesting of which I had described for insertion in the present paper, but at the last hour failed to obtain the donor's permission for so doing, the present list therefore embraces only published species, though it is to be hoped Mr. Blanford will himself soon remedy this, and adopt the course which his prohibition has debarred me from.

Cyclostomidæ.

Cyclophorus.

C. Himalayanus, P.—Not common.

C. Tryblium, B.—Rare.

C. Aurora, B.—Common. This shell varies very greatly in size

as the following measurements shew, 1.95—1.30 to 1.20—0.80, and smaller specimens than this last are not rare.

C. Phœnotopicus, B.—A small species of the pterocycloid group of Cyclophorus.

Megalomastoma.

M. Funiculatum, B.—Tolerably abundant at Darjiling on mossy banks.

M. (?) n. s.—A small pointed scalariform species with strong costulate striation.

Alycæus.

A. Urnula, B.
A. Constrictus, B.
A. Otiphorus, B.
A. Stylifer B.
A. n. s.
A. n. s.
A. n. s.
A. n. s.
A. n. s.

Streptaulus. B.

S. Blanfordi, B.

Diplommatina.

D. Pachychcilus, B.
D. sp.

Helicidæ.

Bulimus.

B. Sikkimmensis, Reeve. Rare.
B. (small sp.)

Achatina.

A. Tenuispira, B.
A. Crassula, B.

Clausilia.

C. Ios, B.

Pupa.

P. (sp.)

Vitrina.

V. (sp.)

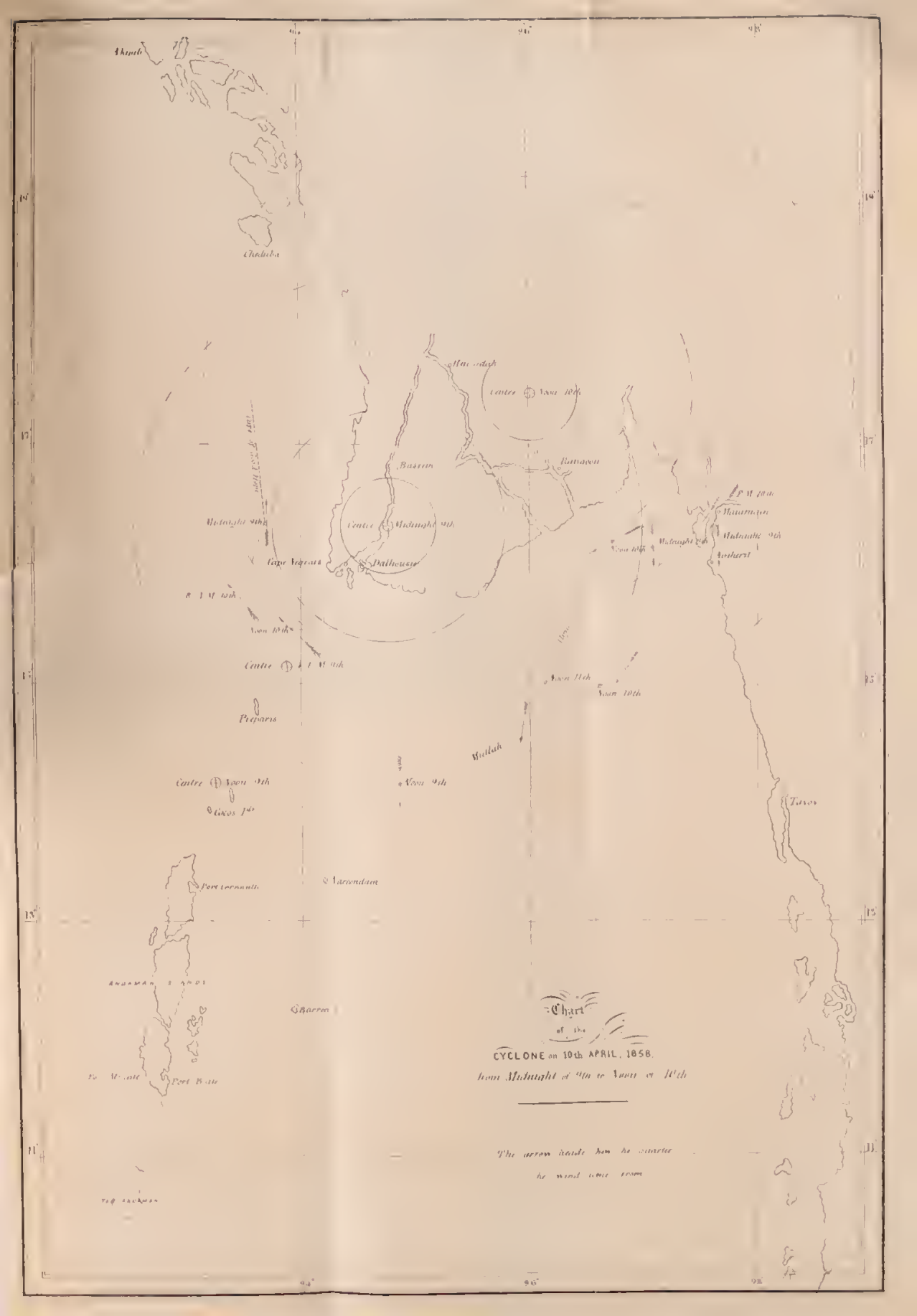
Akyab
Chedooba
Hare Island
Centre Noon 10th
Bassein
Rangoon
Midnight 9th
Cape Negrais
Dalhousie
Noon 10th
Centre Noon 9th
Noon 9th
Noon 11th
Noon 10th
Preparis
Noon 9th
Noon 9th
Cocos Is.
Port Cornwallis
Narcondam
Barren
Port Blair
Tavoy
Chart
of the
CYCLONE on 10th APRIL, 1858.
from Midnight of 9th to Noon of 10th
The arrow beside how he course
he wind came from


Chart
of the
CYCLONE on 9th of APRIL, 1858
and
Noon 9th
Bassein
Rangoon
Centre
Midnight 9th
Amherst
Tavoy
17°
15°
13°
11°

Helix.

H. Cyclophlax, B.

H. Tugurium, B.—Rare.

H. Castra, B.—Rare.

H. Orobia, B.—Rare.

H. Lubrica, B.

H. *Huttoni*, B.

H. Rorida, B.—Common on shrubs in Darjiling during early morning.

H. Climacterica, B.

H. Plectostoma, B.

To this a dozen may safely be added to complete the list, of shells which are undescribed and of which I have not seen specimens.

Calcutta, 30th August, 1858.

Account of a Cyclone in the Andaman Sea, on the 9th and 10th April, 1858.—*By* G. von Liebig, M. D.

The *Friend of India* of the 13th May publishes the following notice: "*The Maulmain Advertiser* records a severe gale in the Bay of Bengal on the 9th and 10th of April and two preceding days. The shipping suffered considerable damage and the Brig *Dido* bound from Rangoon to Penang foundered at Sea; one man was saved, &c. &c."

Having been in the Andaman Sea about that time, doing duty on board the Honorable East India Company's Steam Frigate *Semiramis*, Capt. Campbell, which had left Calcutta on the 4th of March for the Andaman Islands and Maulmain, I had an opportunity of collecting some information with regard to this gale, a well defined Cyclone, the publication of which I think will be of importance for the navigation of the Andaman Sea. I consider the publication of this account the more in the light of a duty, as we have had only lately to regret the loss of Mr. Piddington, who has for a number of years conferred so much benefit on the navigation of the Indian seas by collecting facts illustrative of the laws of circular storms

and by popularising knowledge by which to avoid their dangers. I have no doubt that he would, with his large experience, have done better justice to the subject than I can hope to do, and I am happy to avail myself of this opportunity to pay tribute to his memory.

The Cyclone of the 9th and 10th April deserves particular attention as it followed a direction differing from the common course of Cyclones in the Bay of Bengal, or in the tropical latitudes generally on the northern hemisphere. This course is usually from the south of east to the north of west, but the Cyclone of the 9th and 10th travelled from the south of west to the north of east—(a direction which we are accustomed to see the Cyclones assume only after they have passed the northern tropic)—passing from the north end of the Andamans to the main land and touching the coast a little south-east of Cape Negrais.

In drawing up this account, I am in a great measure indebted to the kind assistance of Capt. Campbell, I. N., whose experience has guided me where I was deficient in nautical knowledge.

The *Semiramis* left Port Blair (11° 41′ north latitude, 92° 45′ east longitude) on the 7th of April for Maulmain. The wind had been blowing from E. N. E., E., and E. S. E. for the whole fortnight previous to our departure, conveying large summer clouds across the Island. On the 6th, the clouds thickened with much lightning, and occasional showers fell, and on the morning of the 7th, the sky was overcast and rainy. Soon after we had left Port Blair on the 7th, the wind turned to south-east with rain and squalls and lightning to southward, but on the morning of the 8th had changed to the north-east, the weather clearing a little. During the day it went to the north and west of north and in the night returned to north-east, from which quarter it continued until we approached Amherst, where we anchored at 1 P. M. on the 9th. Here the wind changed through E. to S. E. during the afternoon of the 9th, the squally weather continuing. During the night with much lightning to the south-east and south the wind increased considerably in force (from 4 to 8 and 9) turning to S. and blowing a gale on the forenoon of the 10th with occasional squalls of rain, but no increase of clouds or unusual electric phenomena during the day, blue patches of the sky being occasionally visible.

The *Semiramis* weighed anchor at noon and proceeded up the river to Maulmain, where she arrived at 2 P. M. The wind after midday gradually changed to S. W. diminishing in force. The readings of the barometers, having followed a most regular course since the day we had left Calcutta, showed on the morning of the 10th a remarkable irregularity. The barometrical curve of the 9th had still been regular, rising from 6 o'clock to 9 and 10, then falling till 4 and 5 P. M. and rising again in the evening. On the 10th the Mercury rose only till 8 o'clock, when it commenced to fall, being at 10 o'clock much lower than it might have been expected, and nearly 0.200 inches lower than the day before at the same hour. (For the observations on board the *Semiramis* as well as abstracts from the logs of the ships mentioned hereafter, vide Appendix.)

The mean barometrical pressure on the 10th (mean of hours 8 A. M. and 4 P. M.) was 0.15 inches lower than the mean of the 9th. On the 11th, the barometer rose again, nearly to its former height and returned to its regular course. The mean temperatures of both days (9th and 10th) were about the same, but with a greater variation on the 10th.

The concurrence of the low and irregular barometric pressure and the increasing force of the wind made it very probable that a Cyclone was passing near, of which we felt the extreme edge, the changes of the wind being slow and the general disturbance in the atmosphere not great. The change in the direction of the wind having taken place from S. E. by S. to S. W. would indicate a position in the right semicircle of the Cyclone, its centre having been nearest on the forenoon of the 10th. A few days after our arrival at Maulmain, we obtained the confirmation of this conjecture.

On the 12th, the survey brig *Mutlah*, Lt. Sweney, I. N. came in, having been obliged to quit her station opposite the middle Andaman in consequence of bad weather, on the 8th April. The *Mutlah* had the first indication of bad weather on the 7th when at anchor in Diligent Straits (vide Appendix). The wind which had before been blowing E. N. E. and E. S. E. the same as at Port Blair, changed on the 7th to S. E. with squalls and rain in the evening. It will be remembered that the *Semiramis* experienced the same change on the same day and in about the same longitude or rather

more to the eastward but further south. On the 8th the gale increased, the wind veering to S. S. E. The Brig now left her anchorage and ran before the gale, standing N. E., the force of the wind still increasing and blowing furiously on the forenoon of the 9th from S. On the 10th the force of the gale moderated, the wind veering to S. S. W. and S. W., the Brig running for the Maulmain river. The barometer continued to fall from the 7th, and was lowest on the 9th.

On the 10th it rose again. According to the veering of the wind the *Mutlah* was also in the right semicircle of the Cyclone and by the barometer nearest to its centre on the 9th, the centre bearing west. Judging from the violence of the weather she experienced, she must have approached it much nearer than the *Semiramis*. She met the gale two days earlier than the *Semiramis*, and further west.

Although the observations of the two Ships coincided so far, it was a strange circumstance that in these latitudes (15° to 17° N.) a Cyclone should travel in the direction indicated, namely, from west to east, the common course of Cyclones in these latitudes being from east to west, and confirmation was still required of the nature of the storm having been that of a Cyclone.

This was given by the Mail Steamer, *Cape of Good Hope*, which experienced bad weather on the 9th, passing along the Arracan Coast from Akyab to Rangoon. With her, the Cyclone set in from the east about noon near Cheduba, the wind increasing and veering round to N. E. and the sympiesometer falling. The violence of the storm was greatest and the sympiesometer lowest about and after midnight, wind N. when she was about forty miles N. W. of Cape Negrais. After this the wind changed to N. W. the storm moderated and ceased at noon on the 10th. The Ship arrived at Rangoon on the evening of the 11th with fine weather.

The wind having commenced with E. veering by N. to W., the *Cape of Good Hope* was evidently in the left semicircle of the Cyclone, and nearest its centre about midnight, on the 9th the centre bearing E.

On the morning of the 9th, when approaching Amherst we had sighted the ship *Alma* on her way from Amherst to Port Blair. She passed us with N. E. wind which she kept till late in the afternoon.

At 9 P. M. a squall from S. E. blew away her main top sail ; at midnight the wind came from S. with terrific squalls, thunder and lightning, the gale blowing till noon on the 10th, when it moderated with S. W. On the 11th the weather was fair with light airs from the westward. The *Alma* in the right semicircle of the Cyclone had been driven N. Westward into the gulf of Martaban, where she had the worst of the storm at midnight from the 9th to the 10th, the centre bearing west, at a time when Amherst partook only of the changes of the wind without experiencing the violence of the gale. From the observations of the *Alma* and the *Cape of Good Hope* it is possible to fix the centre of the Cyclone at midnight on the 9th. Judging from the great violence of the gale at Port Dalhousie where the storm is said to have been worst, it was about forty or sixty miles E. N. E. off Cape Negrais on the main land (vide Charts).

The Honorable East India Company's Steamer *Coromandel* bound for Madras, left Rangoon on the 8th with N. and N. E. wind and rain. She kept the usual course and in 15 latitude, A. M. on the 9th she steamed westward. The Cyclone commenced at 11 A. M. on the 9th, the wind changing from N. to S. E. barometer 29.96. She soon changed her course to W. by N. and W. N. W., the wind veering to E. S. E. at 1 P. M. increasing fast and barometer falling. At 4 P. M. the Ship was a little north of Preparis Island, the wind had suddenly changed to N. N. E. increasing to a heavy Cyclone with thunder and lightning and heavy rain. The barometer falling rapidly, but the urgency of the occasion not leaving time to record the observations.

The Ship now hove to with her head to E. ; much damage was received (vide Appendix). The gale continued heavy, the wind veering to N. W. until 7 P. M. when an observation of the barometer could again be recorded, which was very low 29 20. After that hour the weather moderated, the wind drawing to the westward and the barometer continued rising. It was at 10 P. M., 29.49. From the great violence of the storm experienced about 4 P. M. the sudden change of the wind to the northward, and the rapid as well as great fall of the barometer, the *Coromandel* must have been close to the centre of the Cyclone about that time.

The Cyclone had struck the Ship first with S. E. the same as was the case with the *Mutlah* and *Alma*, but at a later date and to the east of the former, and earlier and to the west of the latter, the *Coromandel* being in a position between these two Ships. This confirms the view already taken of the Cyclone passing from S. W. to N. E. The *Coromandel* instead of passing through the right semicircle of the Cyclone, as the other ships, must have steered right across its tract into the left semicircle, narrowly escaping the centre itself. That she was closer to the centre than any of the other ships is proved, as already mentioned, by the rapid changes of the wind between 1 P. M. and 7 P. M. from E. S. E. to N. W. The observations of the *Coromandel* allow us to fix the centre to about 20 or 40 miles north of Preparis Island at 4 P. M. on the 9th, and its passage to the main land between that hour and midnight is shown by its position at midnight which we have fixed from the observations of the *Cape of Good Hope* and the *Alma*.

We are now also enabled to trace the position of the centre at noon on the 9th. The *Coromandel* had at that time the wind from S. E., the centre bearing S. W. At the same hour the *Mutlah* had the wind from S. the centre bearing west. Proceeding from the positions of the two ships at noon on the 9th these bearings unite in fixing the centre to about ten miles north of the little Cocos Island (vide charts.) This agrees well with the observations of the *Cape*, the wind about noon near Chiduba being east.

It now remains to trace the positions of the centre at noon on the 10th. At that hour, the *Alma* in the Gulf of Martaban, very near the coast had S. W. when the *Cape of Good Hope* about 40 miles S. west of Cape Negrais had N. W. The bearings of the centre from these directions of the wind point to a position about 40 or 60 miles to the North of Rangoon, on the main land. This is further confirmed by the change of the wind about noon at Amherst from S. to S. W., I have delineated the tracks of the ships and that of the storm on the 9th and 10th on the two accompanying charts.

By information received, the storm was not felt at Akyab, but its widest circle about noon on the 9th touched Chidnba Island and shortly after that hour Amherst, where I take the change of the

wind to S. E. and its subsequent veering by S. to S. W. as sufficient evidence. Starting from the position fixed for the centre at noon on the 9th near the Cocos Islands, this would give it a radius of about 300 miles. On the 8th when it commenced, probably a little W. of the *Andamans*, it was felt at Port Blair.

Having fixed the centre for noon of the 9th for the midnight following and for noon of the 10th, we are enabled to form a conclusion as to its rate of travelling and the difference of its speed on the surface of the Sea and on the land. In the period from noon to midnight on the 9th, the centre accomplished a distance of about 160—170 miles and in the 12 hours following about 90—100 miles. Accordingly it travelled at the rate of about 14 miles an hour on the water and of about 8 miles an hour on the land.

The track of the Cyclone does not keep a straight line but is slightly curved, the concavity of the curve pointing to the south-east.

For determining the position of the centre, I have only used such positions of the ships as could be defined with sufficient approach to their real place, as otherwise the uncertainty of some parts of the ship's tracks and also of the observation of the wind's changes when further removed from the centre, would often lead to error.

To complete the information, I mention that by a letter which Capt. Dicey, Master Attendant at Calcutta, had the kindness to communicate to me, the Cyclone caused considerable damage at Henzadah latitude 17° 40′ N. and longitude 95° 15′ E. on the forenoon of the 10th, when its centre passed between that place and Rangoon. The destruction caused at Rangoon was also great, as I conclude from verbal accounts, but it is to be assumed that the violence of the Cyclone must have been considerably lessened by the time it had progressed so far inland. This would also appear from the small disturbance of the atmosphere experienced at Amherst and Maulmain on the 10th.

It will be interesting to mark the limits of the region in which the Cyclone raged, and the winds that prevailed in these limits before and after it.

The region in which the effects of the storm were felt may be included between the 11th and 19th degrees N. latitude and between

the 92° and 98° E. longitude. There is no doubt it must have extended to the west of 92° E. longitude on the 8th and 9th, but, no observations being available, I will not go beyond that limit. In this region the polar current prevailed before the commencement of the gale, as shown by the observations of the *Semiramis*, Port Blair and *Mutlah* before the 7th and of the *Alma* and *Coromandel* on the 8th (Amherst and Rangoon, vide Appendix.) On the 7th and 8th a south-eastern current from the equator first entered the south-western quarter of the region between 93° and 95° latitude. (*Semiramis* and *Mutlah* on the 7th) at a time, when in the eastern half the polar current still prevailed (*Semiramis*, *Coromandel* and *Alma* on 8th.) The entrance of the southern current seems to have introduced the atmospheric disturbance, but the rotatory motion was not observed before the 9th and 10th, when the Cyclone had been formed, travelling now from S. W. to N. E. The *Mutlah's* log makes it probable that the Cyclone took its origin west of the middle Andaman on the 8th.

After the Cyclone had passed, the prevailing winds in the region were westerly, with calms, and later the polar current prevailed again.

To the south-west of the region (latitude 6° 10′ longitude 88°—90° ship *Edwards*) on the 8th and 9th S. westerly winds prevailed, giving way on the 10th to the polar current.

To the north of the region (Dalhousie, Calcutta and Sea and *Cape of Good Hope*, forenoon of 9th.) The S. W. sea breeze common to the coast of Bengal and Arracan, prevailed before as well as after the gale (Dalhousie, Calcutta to 16° 51′ N. latitude and 92° 16′ E. longitude from 7th to 11th.) The log of the *Edward* shows that the south-eastern current, which ushered in the Cyclone, was confined between very narrow limits, not reaching west of the Andamans. It was on the 7th probably confined between longitude 92° and 95° or 96° east longitude.

Appendix.

Memo. from the Log of H. East India Company's Steam Frigate or Semiramis, Capt. Campbell, *and also private Journal.*

6th April.			
7 A. M.	Bar. 29.965	84.00	At Port Blair, sky overcast,
10	30.030	85.00	wind E. S. E., calm in evening.
12	30.015	85.75	
2 P. M.	29.975	86.25	
4	29.945	86.25	
6	29.925	86.25	
8	29.940	85.75	
7th April.			
6-30 A. M.	29.910	85.0	Left Port Blair at 6 A. M., much
8	29.935	83.5	rain during the night with thun-
10	29.970	83.0	der and lightning, wind was
4 P. M.	29.850	82.0	E. N. E. in the morning, changed
6-25	29.850	82.0	in the middle of the day to S. E.
8	29.910	82.0	and remained so till evening, when it was E. S. E., strength of the wind 4—5; much rain with squalls all day. Ports closed since 9 A. M., ship rolling.
8th April.			
6-30 A. M.	29.350	83.75	At midnight the wind lulled
10	30.005	80.75	and then set in from N. E. In
2 P. M.	29.940	81.25	the middle of the day it changed
4	29.940	81.25	from N. E. to the west of N. and
6	29.940	82.00	returned to N. E. in the evening,
8	29.960	81.75	strength 2—4, raining and over- cast all day with some lightning.

Latitude, at noon on 8th 14° 30′ N. by account.
Longitude, ... 96° 10′ E.

9th April.			
6-30 A. M.	29.975	80.5	During the night wind continued N. E. until about 7 A. M., after that hour it turned easterly and about noon became S. E. strength 3—4. At noon we took the pilot on board in sight of Amherst and anchored at 2 P. M., raining with interruptions all day; during the night following the 9th, lightning was observed all round, but principally to S. E. and S.
9	30.040	80.75	
10	30.040	81.0	
12	29.980	81.0	
2 P. M.	29.940	81.5	
4	29.925	81.5	
6	29.920	81.0	
8	29.950	80.5	

Latitude at noon on 9th 10° 4′ N. by account.
Longitude,..... 97° 35′ E.

10th April.			
7 A. M.	29.860	78.00	The wind after midnight of the 9th changed from S. E. to S. and remained so, increasing in strength (8—9) till about noon, when it diminished, the wind gradually changing in the afternoon to S. W., left Amherst at noon and anchored Maulmain about 2 P. M., raining with interruptions all day.
8	29.900	78.50	
10	29.870	80.50	
11	29.875	81.75	
12	29.850	81.00	
2 P. M.	29.830	84.50	
4	29.805	78.50	
6	29.815	79.00	
8	29.800	79.00	
11th April			At Maulmain, wind S. W. and calm, clouds from N. W.

Memo. from the log of the Brig Mutlah, Lt. SWENEY, *I. N.*

7th April.			
	Aneroid Bar.	Temp.	At anchor off North Button, Diligent Straits (middle *Andaman.*) Overcast, slight showers, wind from E. N. E. in the morning turned after 10 A. M. towards S. E. strength increasing as it changed from 2—7 and 9, squally in the evening.
4 A. M.	30.00	84.5	
10	30.02	83.5	
1			
4 P. M.	29.93	82.5	
10	29.98	81.5	

8th April.			
4 A. M.	29 90	83.25	Gale increasing, incessant rain,
10	29.94	84.00	left the Anchorage to gain the
4 P. M.	29.87	83.75	open sea, run before the gale,
10	29.90	84.00	standing to N. E. wind S. S. E. the whole day strength 5—8.
9th April.			
4 A. M. no obs.		„	About midnight of 8th, heavy
10 no obs.		„	squalls, torrents of rain, course
4 P. M.	29.79	81.75	N. E., wind changed to S., at
10 no obs.		„	daylight of 9th stood E. by N. to steer clear of the Cocos and Preparis, and steer out of gale, wind S.
			8 A. M. gale increasing, blowing furiously, torrents of rain and high sea, vessel labouring and straining. Noon slightly moderating, wind S. stood E. N. E.
10th April.			
4 A. M. no obs.		„	At midnight of 9th, heavy sea
10 A. M.	29.93	82	gale, heavy squalls, moderating
4 P. M.	29.89	82.5	after daylight, wind turning to
10	29.74	83	S. S. W. and in afternoon to S. W., moderating; strength of wind during the morning 7—8 and 9, at 4 P. M. 3.
			Running for Maulmain river, ½ past 1, struck soundings 16 fathoms, sand.
			10—30 P. M. anchored in 15 fathoms with Island a head (Calegouk.)

Latitude at noon on 10° 15′ N.
Longitude, ... 96° 34′ E.

11th April.

4 A. M.	29.88	80.5	Under weigh to Caligouk Is-
10	30.00	81	land 3—4 miles E., wind N. west-
4 P. M.	29.94	82.75	erly, clearing up at noon, sighted
10	30.02	84	Amherst Pagoda.

Remark.

The tempest was worst on the morning of the 9th.

Memo. from Log of the Mail Steamer Cape of Good Hope, Capt. Robertson.

9th April.—Proceeding down the coast from Akyab to Rangoon, wind S. W. on the morning of the 9th.

Noon.—Wind E. or E. S. E. threatening appearance, Sympiesometer, 29.95.

2 P. M.—Off Chiduba Island, wind E., barometer 29.90.

8 P. M.—Wind N. E. gale, sympiesometer falling 29.70.

Midnight.—About 40 miles N. W. of Cape Negrais, wind N. sympiesometer 29.49, heavy gale, thunder and lightning, squalls and rain, deck furniture carried away.

10th April.—About 50 miles west of Cape Negrais, wind has gradually changed to N. W. sympiesometer commenced to rise.

Noon.—Passed Negrais channel, wind N. W. moderating.

Remarks.—The gale was most severe shortly after midnight. It ceased in the afternoon of the 10th. The wind veering to W. N. W. and remaining westerly and N. westerly afterwards. Fine weather on the 11th, arrived at Rangoon on the 11th at night. At Port Dalhousie, the cyclone had been worst, two ships were lost on the 9th. At Bassein, also great destruction was caused by the cyclone.

I am indebted for this account to the verbal communication by Capt. Robertson.

Memo. from Log of ship Alma, Capt. D. Ritchie *from Amherst to Port Blair.*

8th April.—At Amherst, a strong breeze from N. W. until about midnight, when it veered to N. E.

9th April.—Left Amherst at 9 A. M., wind N. E., remained so until night.

9 P. M.—A sudden squall from S. E., blew away the main top sail, it moderated again.

Midnight.—Terrific squall from S., with thunder and lightning, gale lasted until noon.

10*th April.*—Noon when it moderated with S. W. course from midnight until noon undecided N. W. or W. The ship drifted until she had only 8 fathoms of water muddy.

11*th April.*—Gale ceased, wind coming round to the westward, light airs at noon.

Latitude 11th at noon 15° 5′ N.
Longitude, ... 96° 7′ E.

12*th April.*—Light airs from the westward, fine weather continued until arrived at Port Blair on 19th.

I am indebted for this account to the verbal communication of Capt. Ritchie.

The track of the *Alma*, as in the chart, was kindly laid down for me by Capt. Campbell, with special regard to drift and local tide currents.

Memo. from the Log of Honorable East India Company's Steamer Coromandel, Lt. STRADLING, *I. N.*

8*th April.*—Left Rangoon, wind North, rain.

4 P. M.—Left Rangoon Bar. Gloomy, and rain N. E. 3.

Midnight.—Wind North, rain.

9*th April*, 9 A. M.—Heavy squalls, confused sea, wind N. E. to N. barometer 29.94.

Thermometer 81.

11 A. M.—Cyclone first struck ship steaming to westward, wind S. E. 6, heavy sea, confused barometer 29.96, rain and gloomy.

Noon.—Latitude 14° 59′ 30″ N., longitude 91° 15′ E. by account.

1 P. M.—High sea from south rolling heads, washed away boat, wind increasing, E. S. E. barometer 29.59, thermometer 82.5, steaming W. by N. and W. N. W.

4 P. M.—Wind N. N. E. increasing fast, heavy cyclone, squalls, with heavy rain, thunder and lightning, barometer falling rapidly. Hove to with head to eastward, sails blown away.

7 P. M.—Wind N. N. W. blowing furiously, cross sea, squally and rain, barometer 29.20 lost jib boom and 24 pr. gun.

10 P. M.—Wind drawing to westward, vessel shipping seas fore and aft, barometer 29.49.

Midnight.—Lost sails, blown away, furled. Barometer rising, slightly moderating.

10*th April*, 4 A. M.—Stood S. W. ward, shipped heavy sea from S. E., ship rolling heavily, wind N. W. to W., passed ship standing to eastward.

Variable winds to westward all the 10th.

Remarks.

Gale was strongest at 4 P. M. on 9th, with wind suddenly increasing to north, barometer falling rapidly till 4, then rising, moderated at 2 A. M. on 10th, confused sea all forenoon. Capt. Campbell had the kindness to procure this memo. for me, and also to lay down the track of the *Coromandel*.

Memo. from Log of Honorable E. India Company's Steamer Dalhousie, Lt. HELLARD, *I. N. from Calcutta to Port Blair.*

7*th April.*—River Hooghly at Calcutta, weather fine, winds variable, barometer at 9 A. M. 29.90 Temp. 83.

8*th April.*—River Hooghly at Calcutta, wind westerly and northwesterly, weather fine, barometer at 9 A. M. 29.96 Temp. 82.

9*th April.*—Proceeding down the river, wind westerly 2—4 barometer 30.00 Temp. 83.

10*th April.*—At 1—30 P. M., the Pilot left the ship, winds between W. and S. 4. Barometer at 9 A. M., 29.97 Temp. 85.

At noon of 10*th.*—Latitude 18° 51′ N. longitude 89° 59′ E.

11*th April.*—Wind S. S. W. 3—4 fine, barometer at 9 A. M. 29.96 Temp. 83.

At noon.—Latitude 16° 52′ N. longitude 92° 16′ E.

12*th April.*—Calm, latitude 14° 36′ N. longitude 93° 41′ E.

Memo. from Log of Ship Edward, from Kurrachee to Port Blair.

7*th April.*—At noon latitude 7° 13′ N. longitude 88° 31′ E., wind northerly and variable with calm.

8th April.—At noon latitude 7° 34′ N. longitude 89° 1′ E. winds S. W., steady breeze and fine.

9th April.—At noon latitude 8° 28′ N. longitude 90° 52′ E. winds S. W. and W. S. W., fresh breeze and cloudy.

10th April.—At noon latitude 10° 23′ N. longitude 92° 40′ E. sighted little Andaman at 8 A. M., wind N. W. all day, fine and steady.

Memo. of observations at Chatham Island, Port Blair, Barometer. By Dr. GAMUMER.

7th April.	*8th April.*	*9th April.*	*10th April.*
Bar. Wind.	Bar. Wind.	Bar. Wind.	Bar. Wind.
Sunrise.—29.82, Easterly.	29.77, South.	29.73, S. W.	29.86, W.
10 A. M.—29.82, N. E.	29.79, S.	29.83, S. W.	29.88, W.
4 P. M.—29.82, N. E.	29.77, S.	29.83, W.	29 92, W.
Sunset.—29.80, E. N. E.	29.77, S. W.	29.85, N. W.	29.92, N.W.

Remarks.—It commenced to blow head at midnight, following the 7th. The position of Chatham Island being confined within the harbour, the indications will not follow the smaller changes in the open sea, but for the greater alterations in the directions of the wind, they are sufficiently close.

On Hypsometrical Measurements by means of the Barometer, and the Boiling-point Thermometer.—By JAMES BURGESS, ESQ.

The whole subject of the barometrical measurement of heights has been investigated by so many eminent physicists since the time of Pascal and Descartes, that it is not to be expected that much that is new can now be added to the theory. The object of this paper is—(1) by correcting the constants used in the latest development of the usual formula, according to the most recent and trustworthy experiments, to render the results obtained in practice as accurate as possible; and,—(2) to deduce formulæ and tables for facilitating the computation of heights by means of the temperature of boiling water, which shall give results more in accordance with the truth than the tables hitherto employed.

I.—*Barometrical Measurements.*

1. The most recent and complete investigation of the theory of the measurement of heights by aid of observations with the barometer, is that of Bessel in the *Astronomische Nachrichten*.* This formula may be written in a general form, thus :—

$$\text{Log}\,\frac{P}{P'} = \frac{(g)(h'-h)}{L\ (1+at)}\left\{1-a.\frac{(1-d)\,p}{\sqrt{P\,P'}}\right\}$$

where—

P is the weight or pressure of the atmosphere at the lower station, and P′ that at the upper, the unit of pressure being that exerted by a column of mercury of 336.905 Paris lines or 29.9218 English inches at the sea-level in latitude 45°.

h is the approximate height of the lower station, and h' of the upper, above the level of the sea; so that if H, and H′ respectively represent the true altitudes of the stations and r the radius of the earth, then—

$$h = \frac{r\,H'}{r+H}, \text{ and } h' = \frac{r\,H'}{r+H'}.$$

(g) is the ratio of the force of gravity at the sea-level in the latitude λ, of the two stations to that at the sea-level in latitude 45°.

a, denotes the fraction of mean saturation of the stratum of air between H and H′, and taking the fractions of mean saturation at the two stations, we may use for that of the stratum $\frac{1}{2}\,(a + a'.)$

a is the co-efficient of dilatation of the air for an increase of 1° of temperature, t denotes the mean temperature of the stratum reckoned from freezing point.

d is the density of vapour in terms of that of air ;

P, the tension of vapour of the temperature t. And

L, a constant dependant on the relative density of the air and of mercury.

2. But, in order to obtain accurate results by means of this formula, it is of importance that the constants should be determined as accurately as possible.

* See Schumacher's Ast. Nach. No. 356. Taylor's Mem. Vol. II.

Now (g), which depends on the variation of gravity between the equator and the poles, has the form—

$$(g) = 1 - \tfrac{1}{2}\, n \cos.\, 2\,\lambda.$$

where n is $\frac{5}{2}$ times the ratio of the centrifugal force to gravity at the equator, diminished by the ellipticity of the earth. Slightly different values have been deduced by different philosophers for the value of n,* but with Bessel we may adopt—

$$\tfrac{1}{2}\, n = 0.0026257\,;$$

and consequently we have

$$(g) = 1 - 0.0026257 \cos.\, 2\,\lambda.$$

3. The constant L is the most important, and depends on the density of the air in terms of that of mercury; thus, B being the standard height of the barometer at the level of the sea in latitude 45°; D, the density of air under the pressure B of mercury in terms of the density of mercury, and M the modulus of the common logarithms—

$$\mathrm{L} = \frac{\mathrm{B}}{\mathrm{D\ M}}.$$

Bessel, in determining the value of L, has derived it from the experiments of Arago and Biot on the weight of air, whence he finds

$$\mathrm{D} = \frac{1}{10466.8}.$$

Ritter, however, has shewn that according to Regnault's experiments, the weight of a litre of air containing the average amount of 0.0004 of its volume of carbonic acid and under a pressure of 760 mm. of mercury is 1.2934963 gramme.† Now the latitude of the college in Paris is 48° 50′ 14″, and the height above the sea is

* If for the ratio of the centrifugal force to gravity we adopt the value $\frac{1}{289.4}$, and Bessel's value of the ellipticity $\frac{1}{299.15}$ we have $n = \frac{5}{2}\left(\frac{1}{289.4} - \frac{1}{299.15}\right) =$ 0.0052964, or $\frac{1}{2}\, n = 0.0026482$; Laplace, Gauss and Littrow used for $\frac{1}{2}\, n$ the value 0.002845; Poisson (Traité de Mécanique 2nd ed.) gives $\frac{1}{2}\, n = 0.002588$; Sabine from his pendulum experiments infers that $\frac{1}{2}\, n = 0.0025914$; and Baily (Mem. Ast. Soc. vol. vii. p. 94) gives .0025659.

† Memoires de la Société de Physique de Genève, tom. iii. p. 361.

60 metres. And Poisson has shewn* that the force of gravity at the height z above the mean level of the sea is—

$$\left\{1-\left(2-\frac{3\,\rho'}{2\,\rho}\right)\frac{z}{r}\right\}\times \text{force of gravity at the sea level;}$$

where ρ' is the density of that part of the earth above the mean level of the sea, and ρ the mean density of the earth. Hence the weight of a litre of dry air at the level of the sea, in latitude 45° under a pressure of 29.9218 inches is—

$$1.2934963 \div \left\{\left(1-1.32\frac{z}{r}\right)\left(1-.0026257\cos 97°\,40'\,28''\right)\right\}$$

$$= \frac{1.2934963}{1.00033847} = 1.2930586 \text{ gr.}$$

Now, if we take the standard height of the English barometer as 30 inches, we have for the weight under that pressure at 32° Faht. ;—

$$\text{As } 29.9218 \text{ in.} : 30 \text{ in.} :: 1.2930586 \text{ gr.} : 1.296438 \text{ gr.}$$

But the weight of a litre of mercury is 13596 gr., and hence,—

$$D = \frac{1296438}{13596} = \frac{1}{10487.2},\dagger$$

and since $30 \text{ in.} = 2.5$ feet and $M = 0.43429448$, we have,—

$$L = \frac{B}{D.\,M} = \frac{2.5 \times 10487.2}{0.43429448} = 60369.15 \text{ feet.}$$

4. a, or the co-efficient of the dilatation of the air has usually been taken from the experiments of Gay Lussac, who found the expansion between the freezing and boiling point of water to be 0.375 of its volume at 32° Faht.; Rudberg found 0.3648; Magnus 0.365508;

* Poisson, Traite de Mecanique, tom. ii. p. 629.

† Under a pressure of 29.9218 in., $D = \frac{1.2930586}{13596} = \frac{1}{10516.46}$, or $\frac{1}{472}$ part of itself less than Bessel's value; and $L = \frac{2.49304}{D\,M} = 60369.15$ feet as above.

and Regnault 0.36706. Adopting 0.367 as the total expansion between 32° and 212° Faht. we have for 1° Faht.—

$$a = 0.0020389.$$

5. The value of d, or the density of aqueous vapour in terms of that of the air, used by Bessel was 0.62 as found by Berzelius; Regnault's experiments give 0.621 as a more accurate determination, and hence $1 - d = 0.379$.

6. Again p, the pressure of aqueous vapour in terms of that of the atmosphere at the temperature $t°$ reckoned from freezing point, may be determined by Regnault's formula, or from any table calculated by means of that formula.

In the usual tables of tensions computed from Regnault's formula, the tensions are expressed in inches of mercury,* and if we put p' for these values we have—

$$p' = 29.9218\ p.$$

7. Lastly, the geometrical mean of the two semidiameters of the earth, according to Airy† is

$$r = 20{,}888{,}733 \text{ feet.}$$

8. Now if B and B′ be the heights of the barometer at the lower and upper stations reduced to 32° Faht.—

$$\mathrm{P} = \frac{\mathrm{B}}{30} \times (g) \left(\frac{r}{r + \mathrm{H}}\right)^2, \text{ and } \mathrm{P} = \frac{\mathrm{B}'}{30} \times (g) \left(\frac{r}{r + \mathrm{H}'}\right)^2;$$

and since h is nearly equal to H,—

$$\mathrm{Log} \frac{\mathrm{P}}{\mathrm{P}'} = \log \frac{\mathrm{B}}{\mathrm{B}'} + \frac{2\,\mathrm{M}\,(h' - h)}{r};$$

and with sufficient accuracy for our purpose—

$$\sqrt{\mathrm{P}\,\mathrm{P}'} = \frac{\sqrt{\mathrm{B}\,\mathrm{B}}}{30}.$$

* See a Table of this kind in Dixon's Treatise on Heat, p. 257—260.

† See Herschel's Outlines of Astronomy, sec. 206.

Substituting these values in the formula, we have

$$\text{Log}\frac{P}{P'} = \frac{(g)\ (h'-h)}{L\ (1+at)}\left\{1 - a.\ \frac{0.379\ p'}{\sqrt{P\ P'}}\right\}, \text{ and—}$$

$$\text{Log}\frac{B}{B'} = \frac{(g)\ h'-h)}{L\ (1+at)}\left\{1 - \frac{2\ M.\ L\ (1+at)}{(g)\ r} - \frac{a\ 0.379\ p'}{\sqrt{B\ B'}}\right\}.$$

Replacing a, by $\frac{a+a'}{2}$, and introducing the values of 2M, L, and r, in the factor within the parenthesis, this equation becomes

$$\text{Log}\frac{B}{B'} = \frac{(g)\ (h'-h)}{L\ (1+at,)} \times$$

$$\left\{\frac{(g)\ 20888733 - 52436\ (1+at)}{20888733\ (g)} - \frac{0.1895\ p'.\ a+a'}{\sqrt{B\ B'}}\right\},$$

and without any sensible error,—

$$\text{Log}\frac{B}{B'} = \frac{(g)\ (h'-h)}{L\ (1+at)}\left\{\frac{397.37 - at}{398.37} - \frac{(a+a').\ 0.1895\ p'}{\sqrt{B\ B'}}\right\}$$

$$= \frac{(g)\ (h'-h)\ (397.37-at)}{398.37\ (1+at)\ L}\left\{1 - \frac{(a+a').\ 75.49\ p'}{(397.37-at)\ \sqrt{B\ B'}}\right\}$$

Hence, we have for the approximate height,

$$h'-h = (\log B - \log B') \times \frac{398.37\ (1+at)}{397.37-at,} L \times \frac{1}{(g)} \times \frac{1}{1 - \frac{a+a'}{\sqrt{B\ B'}} \cdot \frac{75.49\ p'}{397.37-at}}.$$

and for the true height—

$$H' - H = h' - h + \frac{h'^2}{r-h'} - \frac{h^2}{r-h}.$$

It remains to adapt these formula for tabular computation; and for the sake of brevity let us write

$$A = \frac{398.37}{397.37-at}.\ L\ (1+at),$$

$$\text{and } C' = \frac{75.49}{397.37-at}.\ p',$$

both which depend on t, the half sum of the temperatures at the two stations, so that we may write $t = \frac{1}{2}(t + t') - 32°$, t and t′ being the temperatures of the air at the lower and upper stations respectively in degrees Faht. The values of log A and log C′ are tabulated in the first table at the end of this with the argument $\frac{1}{2}(t + t')$

The whole factor dependant on the humidity of the air may be written—

$$C = \frac{1}{1 - C'.\frac{a + a'}{\sqrt{(B B')}}}$$

and its logarithm is given in Table II with the argument—

$$\text{Log} \frac{C'(a + a')}{\sqrt{B B'}}.$$

For the term giving the correction for latitude we may write—

$$G = \frac{1}{(g)} = \frac{1}{1 - 0.0026257 \cos. 2\lambda},$$

and tabulate log G for the different values of λ, as in Table III. Then:—

$$\text{Log}(h' - h) = \log(\log B - \log B') + \log A + \log C + \log G.$$

And lastly from Table IV a small correction due to the decrease of gravity above the sea-level is found, and the quantity $\frac{h'^2}{r - h'}$ there given, is to be added to $h' - h$, and the value of $\frac{h}{r - h}$ is to be subtracted, giving

$$H' - H = h' - h + \frac{h'^2}{r - h'} - \frac{h^2}{r - h},$$

for the true difference of altitude of the two stations in feet.

In using the tables, it must be observed that τ and τ′ being the temperatures of the mercury at the two stations and b, b' the *observed* heights of the barometer,

$$\text{Log } B - \log B' = \log b - \log b' - 0.0000435(\tau - \tau')$$

when the expansion of the mercury alone has to be taken into account; but when the scale of the barometer is brass and extends from the cistern—

$$\text{Log B} - \log \text{B}' = \log b - \log b' - 0.00003905\ (\tau - \tau').$$

Example.

M M Bravais and Martins made the following observations:—On M. St. Bernard 8114 feet above the level of the sea $\text{B} = 568.03$ mm., $t = 7.6$° Cent. or 45.7° F. and $a = 0.59$; and on M. Blanc $\text{B}' = 424.29$ mm., $t' = -9.1$° C. or 15.3° F. and $a' = 0.57$.

Here

$\text{B} = 22.364$ in.. log 1.34955	$\frac{1}{2}(t + t') = 30.6$° F.
$\text{B}' = 16.705$.. log 1 22284	$a + a' = 1.16$
Diff. 0.12671.. log 9.102811	$\sqrt{\text{B B}'}$.. log 8.7138 — 10
Table I, ... Log A. 4.780555	Tab. I. log C′ 8.5078
Table II, ... Log C. 0.000842	$a + a'$.. log 0.0645
Table III,.... Log G.—0.000033	$\text{C}'.\ \frac{a + a'}{\sqrt{\text{B B}'}} = 7.2861$
$h' - h$ ... 7659 ft. .. log 3.884175	

Then by Table IV. 7659 + 12.9 — 3.2 + 8114 = 15782.7 feet the height.

II.—*Measurement of Heights by the Boiling Point of Water.*

1. It has long been known that the temperature of ebullition is lowered, as the pressure under which a fluid boils is decreased. This was first used by Archdeacon Wollaston, about 1817, as a means of measuring altitudes. Wollaston, however, in drawing up his table of heights corresponding to different temperatures of boiling water, made use of the empirical formula of Dr. Ure, for the elasticities of steam of different temperatures, and which was not calculated to give accurate results.

In the Journal of the Asiatic Society for 1833, the late Mr. James Prinsep discussed the subject, using Tredgold's formula for the tension of steam, but modifying the results to make them agree

as nearly as possible with the experiments of Ure, Southern and Dalton.* From these results, he calculated a table of heights corresponding to the boiling point for each degree of temperature from 176° to 214°. From observations made simultaneously with the barometer and boiling point thermometer, Colonel Sykes inferred that Prinsep's table gave altitudes generally less than those indicated by his barometer. Sykes made no observations at greater altitudes than 4500 feet, but at that height, the average error in Prinsep's table, seems to be over 100 feet.

This subject has since been discussed in a paper by Professor J. D. Forbes, published in the transactions of the Royal Society of Edinburgh for 1842-3, founded on observations made among the Alps. By projecting the elevations as derived from barometrical observations, but uncorrected for temperature, in terms of the observed boiling points, he found that a straight line passed almost quite through the whole of the projected points. Hence he inferred "*that the temperature of the boiling point varies in a simple arithmetical ratio with the height.*"

2. This hypothesis seems to require examination. The general form of the formula for heights as measured by barometrical observations is,—

$$h = \mathrm{L} \times \log \frac{\mathrm{B}}{\mathrm{B}'};$$

where B′ and B are the heights of the barometer at the upper and lower stations respectively, h the difference of elevation, and L the constant determined in the preceding section. But were Professor Forbes's hypothesis true, we should have—

$$\mathrm{T} - \mathrm{T}' = n \log \frac{\mathrm{B}}{\mathrm{B}'}, \quad \ldots\ldots\ldots\ldots \quad (1)$$

T and T′ being the boiling temperatures at the two stations or under the pressures B and B′ respectively. And combining these formula, we obtain—

$$h = \frac{\mathrm{L}}{n} (\mathrm{T} - \mathrm{T}') \ldots\ldots\ldots\ldots \quad (2)$$

as the expression for the approximate height.

* Jour. Asiat. Soc. of Bengal, April 1833, pp. 194 200.

Now, in order to determine whether the hypothesis is correct or not, it is only necessary to discover whether or not the quantity n, as derived from observations made at different altitudes is constant. In the following table I have collected a few observations made by Professor Forbes,* Dr. Hooker,† M. Marié,‡ and others, tabulating in column (5) the value of n derived from each, and in column (6) the boiling point corresponding to the observed pressures given in column (3) calculated on the supposition that $n = 112$. Column (7) shews the differences between these and the observed values.

(1) Station	(2) Observer	(3) Barometer in inches and at 32° F.	(4) Observed boiling point corrected	(5) Calculated value of n.	(6) Calculated boiling point from $n = 112$.	(7) Diff.
Gt. Rungeet River.	Dr. Hooker.	29.211	210.°8	103.91	210°.70	—0°.10
Martigny.	Dr. Forbes.	28.489	209.5	117.29	209.61	+ 0.11
Mont Pila.	M. Marié.	28.207	209.05	115.19	209.13	+ 0.08
do. „	do.	26.258	205.48	114.88	205.65	+ 0.17
do. „	do.	25.819	204.71	113.82	204.83	+ 0.12
Churra, Khasia Mts.	Dr. Hooker.	25.596	204.3	111.68	204.28	— 0.02
Mont Pila.	M. Marié.	25.433	203.88	115.01	204.09	+ 0.21
Gressonay.	Dr. Forbes.	25.143	203.58	111.4	203.54	— 0.04
Choongtam.	Dr. Hooker.	24.697	202.5	112.46	202.54	+ 0.04
Myrung, Khasia.	do.	24.453	201.9	113.75	202.06	+ 0.16
Prarayon.	Dr. Forbes.	23.893	200.96	113.0	201.06	+ 0.10
Darjiling.	Dr. Hooker.	23.358	199.6	114.09	199.83	+ 0.23
Tacul.	Dr. Forbes.	23.353	199.98	111.7	199.94	— 0.04
do.	do.	23.154	199.48	112.43	199.53	+ 0.05
St. Bernard.	do.	22.674	198.46	112.4	198.51	+ 0.05
Zemu Samdong.	Dr. Hooker.	21.605	195.9	112.93	196 03	+ 0.13
Col Collon.	Dr. Forbes.	20.77	194.53	110.16	194.24	— 0.29
Mainom, Sikkim.	Dr. Hooker.	20.48	193.4	112 19	193.43	+ 0.03
Yeumtong, do.	do.	19.49	191.1	111.58	191.02	— 0.08
Tungu, do.	do.	18.869	189.5	111.73	189.45	— 0.05
Mont Blanc.	Saussure.	17.133	187.23§	109.97	186.89	— 0.34
Pichincha.	M. Wisse.	17.208	185.27	111.26	185.09	— 0.18
Yeumtso, Sikkim.	Dr. Hooker.	16.385	183.2	109.64	182.58	— 0.62
Sebolah Pass, do.	do.	16.928	181.9	109.48	181.21	— 0.69

* Edin. Phil. Trans. vol. xv.

† Given in a second paper by Prof. Forbes, Edin. Phil. Trans. vol. xxi. part 2.

‡ Quoted by Regnault, Ann. de Chim. et de Phys. July 1844.

§ Saussure's boiling-point, 80° R., corresponded to a pressure of 27 French inches.

The numbers in columns (5) and (7) of this table at once shew that whilst the hypothesis of Professor Forbes is not rigorously true, n decreasing with the temperature, it is still a very good approximation when the heights are under 10,000 feet, or the boiling-point above 193° Faht.; and as 112 is about the mean value of n, we have by substitution in equation (2), and using 60369 feet as the value of L,—

$$h = 539.01\ (T - T'), \quad \ldots\ldots\ldots\ldots \quad (3)$$

as the expression for the height uncorrected for the temperature of the air. Professor Forbes, in the paper above referred to, gives 549.5 as the value of the co-efficient, and in a later paper on the same subject he proposes 543.2 feet as best representing observations when the boiling-point is above 190° Faht. or when the heights are under 12,000 feet; but when the boiling-point is above 192° F., he states in a note that the co-efficient should be only 535 feet, in order to express the heights as derived from Regnault's table of tensions.

3. After making due allowance for errors of observation, it is evident that the values of n in column (5) of the preceding table, decrease with the temperature. Hence, in order to derive a formula which shall *accurately* represent heights in terms of the boiling-point of water, it is only necessary to determine the value of n at the standard boiling-point, and the mean rate of its variation for temperatures near that point. For this purpose Regnault's tension series, from the method by which he obtained his experimental values, may be taken as representing the pressures under which water boils at different temperatures.* For temperatures near 100° Cent. however, Moritz has shewn that the values in Regnault's table are slightly in error on account of the constants not having been calculated with sufficient accuracy. Moritz has corrected and published the values of the tensions where they differ from Regnault's.† In what follows, I have used these corrected values.

Now, from equation (1) we at once derive,—

* Ann. de Chim. et de Phys. July 1844. Forbes, Edin. Phil. Trans. vol. xxi part II. p. 238.

† Bullet. de la classe Physico-math. de l' Acad. de St. Petersbourg, xiii. 41

$$n = \frac{T - T'}{\log B - \log B'} \quad \ldots\ldots\ldots\ldots \quad (4)$$

and hence when B = B', and T = 100° cent. using Moritz's values, we have

$$n = \frac{d\,T}{d.\log B} = \frac{B.\,d\,T}{M.\,d\,B} = 64.307626 \ldots \quad (5)$$

and when T' = 80° C., we have, by equation (4)—

$$n_{80} = \frac{20}{\log B_{100} - \log B'_{80}} = 60.412836$$

and as the value of n is found to vary pretty regularly with the temperature between these two points, we may write—

$$n_T = 64.30763 - \frac{n_{100} - n_{80}}{20}(100 - T)$$

$$= 64.30763 - 0.1947445\,(100 - T) \quad \ldots\ldots \quad (6)$$

Substituting this value in equation (4) we find—

$$\text{Log B}_{100} - \log B_T = \frac{100° - T}{64.3076 - 0.19474\,(100 - T)}$$

$$= \frac{5.13493\,(100 - T)}{330.215 - (100 - T)} \quad \ldots\ldots\ldots \quad (7)$$

We obtain a result almost identical with this by applying the method of least squares to the logarithms of Moritz's tensions at 80°, 85°, 90° and 95°, viz.—

$$\text{Log B}_{100} - \log B_T = \frac{5.108555\,(100 - T)}{328.62566 - (100 - T)} \ldots \quad (8)$$

either of the equations (7) and (8) will give the logarithms of the pressures in millimetres of mercury for temperatures between 80° and 100° C. generally correct to the 5th or 6th decimal place, by using the following values.

For $\log B_{100} = \log 760^{\text{mm.}}$	2.8808136
For log 5.108555	0.7082981

If now we combine equations (2) and (8) and introduce the value of L for a standard atmosphere at 0° Cent, the approximate height is

$$h_m = 94082 \times \frac{100 - T}{228.626 + T}, \qquad (9)$$

$$\text{and } \log h_m = 4.973506 + \log (100 - T) - \log (228.626 + T),$$

when expressed in metres above the point where water boils at 100° cent.

4. Now if the boiling-point on Fahrenheit's scale coincided exactly with that on the centigrade, that is if 212° F. represented the temperature of boiling water under a pressure of 29.9218 inches of mercury,* this formula, and the logarithms of the pressures in the table of Moritz might at once be modified to suit the English scales. But if the thermometer be so constructed that the boiling-point is at 212° F. under 30 inches of pressure, the centigrade ought, in the same circumstances, to shew 100°.0729; and as the freezing point may be considered invariable, 176° F. will coincide with 80°.0583 C. To make the necessary correction for this difference, which is often overlooked, I have, after interpolation among Moritz's pressures, derived the following formula of essentially the same form as that first used by Biot,† and which accurately represents the results derived from Moritz's table,—

$$\text{Log } B_T = \log 30 - 0.00864156\text{6} (212° - T) - 0.0000143365 (212° - T)^2 - 0.00000003161 (212° - T)^3. \qquad (10)$$

This formula, which is adapted to Fahrenheit's scale, will give the same results as the more complicated one of Regnault when T lies between 172° and 216° Faht. The values of the logarithms of the pressures in the table of Moritz may, in like manner, be represented between 78° and 102° C. by the formula,—

* "J' adopterai les températures, au thermomètre à mercure, divisé en cent degrés, depuis la température de la glace fondante, jusqu'à celle de l'eau bouillante sous une pression équivalente au poids d'une colonne de mercure, de soixante et seize centimètres de hauteur." *Laplace, Exposition du Système du Monde —avertissement.*

† Biot, Traité de Physique (1816) tom. I. p. 278; also Ency. Metropol. (1845) vol. iv. p. 249.

$$\left.\begin{aligned}\text{Log } B_T = \log \overset{\text{mm.}}{760} &- 0.01555026\ (100° - T) \\ &- 0.0000164227\ (100° - T)^2 - 0.00000018515\ (100° - T)^3\end{aligned}\right\}$$

By means of equation (10), Table V. has been constructed, giving the logarithms of the pressures in inches of mercury for every fifth part of a degree from 176° to 215° F.; and from the same equation we derive for Fahrenheit's scale—

$$n = \frac{\text{B. } d\text{ T}}{\text{M. } d\text{ B}} = 115.71976,$$

and from the table, by least squares,—

$$\text{Log } \overset{\text{in.}}{30} - \log B_T = \frac{212° - T}{115.71976 - 0.1957\ (212 - T)}$$

$$= \frac{5.108273\ (212 - T)}{379.319 + T} \quad \ldots\ldots\ldots \quad (11)$$

where log 5.108273 = 0.7082741.

And, as before, the elevation in feet above the point where water boils at 212° Faht. will be found by multiplying the right hand side of this equation by L = 60369 feet, viz.:

$$\left.\begin{aligned}h &= \frac{308382\ (212 - T)}{379.319 + T}, \\ \text{or } \log h &= 5.488089 + \log (212 - T) - \log (379.319 + T).\end{aligned}\right\} (12)$$

5. If the boiling-point be observed at two stations, whose difference of level is required,—writing D = 212° — T, and D′ for 212° — T′, we have,—

$$\left.\begin{aligned}h' - h &= \frac{308382\ (T - T')}{167.319 + (T + T') + 0.00169\ DD'}, \\ \text{or, since } 0.00169 \text{ is very nearly } &\frac{1}{600}, \text{ we may use } \frac{DD}{600'}, \\ \therefore \text{Log } (h' - h) &= 5.488089 + \log\ (T - T') \\ &\quad - \log\ (167.319 + T + T' + \frac{DD'}{600})\end{aligned}\right\} (13)$$

6. The same value of h as found from equation (12) may also be derived, in a different form, from equation (10), by multiplying log 30 — log B by L, thus :—

$$h = 521.684\ (212 - T) + 0.8655\ (212 - T)^2 + 0.0019\ (212 - T)^3 \quad \ldots\ldots\ldots\ldots \quad (14)$$

or, as a good approximation in two terms,—

$$h = 520.476\ (212 - T) + 0.967\ (212 - T)^2 \ldots \quad (15)$$

7. For the height in *metres* in terms of T on the Centigrade scale, we may, instead of equation (9), use,—

$$\left.\begin{aligned} h_m = 286.2\,(100 - T) + .8546(100 - T)^2 + 0.00341\ (100 - T)^3, \\ \text{or approximately, } h_m = 285.54\,(100 - T) + 0.955\ (100 - T)^2. \end{aligned}\right\} \quad (16)^*$$

8. The equations now deduced for expressing the height in terms of the boiling-point of water require to be corrected in the same manner for the temperature of the air, &c. as those derived from barometrical observations. Hence substituting equation (11) in the formula already given for the barometer, and omitting the terms depending upon the hygrometrical state of the atmosphere, and the diminution of gravity with the height, we have for the correct height—

$$H' - H = \frac{5.10827\ (T - T')}{167.319 + T + T' + \frac{1}{600}\ D\ D'} \times L. \frac{398.37\ (1 + at)}{397.37 - at} \times \frac{1}{(g)} \quad \ldots\ldots\ldots\ldots \quad (17)$$

or, adopting the notation already employed—

* Professor Forbes has arrived at almost exactly the same results. For equation (15), he gives—

$$517\ (212° - T) + (212° - T)^2;$$

and for equation (16)—

$$h_m = 284\ (100 - T) + (100 - T)^2;$$

the equation—

$$h = 519.66\ (212° - T) + (212° - T)^2$$

will give almost exactly the same results as equation (15).

$$\left.\begin{aligned}\text{Log } (H' - H) = 0.708274 + \log (T - T') \\ - \log \left(167.319 + T + T' + \frac{DD'}{600}\right) + \log A + \log G.\end{aligned}\right\} \quad (18)$$

9. To facilitate computations of this kind, Tables V and VI have been formed. Table VI gives the height in feet above the level where water boils at 212° Faht. for every fifth part of a degree between 176° and 215° F. This Table and the column containing the *Multiplier* for the mean temperature of the air in Table I will enable us to obtain the heights, uncorrected for latitude, without the use of logarithms. Table V containing the logarithmic pressures will be of use when one of the observations is taken with a barometer.

10. When the observations are taken at the upper station only, it becomes necessary to estimate t, the mean temperature of the stratum of air between the sea level and that station approximately. Laplace estimated the diminution of temperature with the elevation at 16° or 17° cent. for 3000 metres of ascent,* but taking the mean of observations made on mountain sides by Saussure, Kaemtz, Bravais, Martins, Schouw, Humboldt, Boussingault, and the recent French Commission to the North, the diminution is 1° Faht. for every 303 feet of ascent.† Hence we may reckon that for every degree which the boiling-point falls, the temperature of the air decreases 1°·8 F., so that the mean temperature may be estimated at,—

$$\tfrac{1}{2}(t + t') = t' + 0.9\,(212° - T'),$$

or when the observation is made with the barometer,

$$\tfrac{1}{2}(t + t') = 91\tfrac{1}{2} + t' - \frac{190\,B'}{30 + B'},$$

or, roughly—

$$\tfrac{1}{2}(t + t') = 60 + t' - \frac{9}{4}B'.$$

* Laplace, Systeme du Monde, tom. i. p. 172 (Ed. 1836.)

† On this subject, see a paper by Professor Challis, in the Transactions of the Cambridge Philosophical Society, vol. vi.; and Daniell's Meteorology, vol. i. pp. 40, 41.

11. With respect to the method of making observations with the boiling-point thermometer, it is only necessary to observe that the instrument described by Professor Forbes in the paper already referred to* seems the most convenient and trustworthy of any that has been proposed, and very superior to that described by Colonel Sykes,† and still more so to that manufactured by Casella and sold in India along with Prinsep's Table—an instrument which never could bo expected to give accurate results. Professor Forbes's boiling apparatus consisted of a thin copper pan heated by a "Russian Furnace," having a powerful jet of inflamed alcoholic vapour, which might be removed to one side until the escape of steam became uniform and moderate, and could be used in a gale of wind. The thermometer had its bulb immersed in the water, of which a moderately large quantity is requisite to a good result.

Tho following examples will shew the use of the tables and formulæ.

Example I. The following data are given in "Smith and Thuillier's Manual of Surveying" (p. 436)—Boiling-point at the lower station 208°.7 and temperature of the air 83°; at the upper station B. P. 204°.2, and air 75° Faht., to find the difference of elevation,

By the formula (18)—

$D = 212 - 208.7 = 3.3$. $D' = 212 - 204.2 = 7.8$.

And $DD' = 25.7$. $T + T' = 412.9$. $T - T' = 4.5$.

And $\frac{1}{2}(t + t') = 79°$.

Now $167.32 + 412.9 = 580.22$

$$+ \frac{25.7}{600} = 0.04$$

580.26. ar. co. log 7.23638 — 10.

$T - T' = 4.5$ ..... log 0.65321.

$\frac{1}{2}(t + t') = 79°$ ..... log A 4.82175.

Const. log 0.70827.

Height 2628 feet ..... log 3.41961.

* Edin Trans. vol. xv.

† See Journal of the Royal Geographical Society, vol. viii. p. 436.

Otherwise, by Table VI.

Height corresponding to	204°.2	4123 feet
„ „ „	208.7	1731 „
Difference, or Approximate height, ...		2392 „
79° Multiplier from Table I, ...		1.099
Corrected height, as before, ...		2628 feet.

Col. Sykes by barometrical observations finds the height 2649 feet, the difference being within the limits of error of observation.

Example II. The following data are partly taken from Prof. Forbes's paper.—Saussure's boiling-point, 80° R. was adjusted at 27 French inches, or 28.777 English. At that pressure the standard thermometer shewed 209°.96. De Saussure's stood therefore 2°.04 F. higher. Now on the top of Mont Blanc, the boiling-point was 187°.23 F. or reduced to the standard thermometer 185°.19 F. and at Geneva, 1345 feet above the sea-level, the barometer indicated 27.267 French, or 29.063 English inches, the mean temperature of the air being about 55° F.

Here, $\overset{\text{in.}}{29.063}$	log	1.463304
$T' = 185°.19$ (Table V.) „		1.234523
Diff. of logs 0.228781 ..	log	9.35942.
$\frac{1}{2}(t + t') = 55°$	log A	4.80186.
Height above Geneva 14497 ft.	log	4.16128.
Geneva above the sea 1345		
Height of M. Blanc 15842 feet,		

being almost exactly the height found barometrically by Saussure, and only 55 feet more than MM. Bravais and Martins's determination, and 59 feet higher than Corabeuf's trigonometrical measurement. The same result may also be found otherwise, thus:—

By Table VI. height corresponding to 185°.19	14645 feet.
By Barometrical Tables the diff. of heights corresponding to 30in. and 29in.063	834
Difference, or approximate height, ...	13811
$\frac{1}{2}(t + t') = 55°$, Multiplier from Tablo I.	1.0497
Corrected height, as before, above Geneva, ...	14497 ft.

Example III. (Boileau's Tables, Int. p. xix.) At the Parang Pass in lat. 32°¼ N. the observed temperature of the boiling-point was 179°.3, the temperature of the air being 27° F. to find tho altitude of the pass above the level of the sea.

Here, by the formula, $\frac{1}{2}(t + t') = 27° + 0.9\ (212 - 179.3) = 56°$.

Approximate height by Table VI.	18052 feet
$\frac{1}{2}(t + t') = 56°$ .. Multiplier by Table I.	1.0517
Corrected height above sea-level, ...	18985 feet

differing from Boileau's result principally from the higher valuo assigned to *t*, and partly from the standard pressure in Boileau's table being 29in.921 instead of 30in., which gives a difference of about 60 feet in the elevation.

12. A small correction ought to bo applied on account of the variation of the pressure at the level of the sea in different latitudes from a standard of 30 inches. Tables V ahd VI aro calculated on the hypothesis that the pressure of the atmosphero at the level of the sea is 30 inches. Observations prove that tho mean pressure varies in different latitudes, and according to the experimental and theoretical observations of Munke and others, tho following short table has been constructed shewing, in column (2), the height of the barometer in different latitudes equal to a height of 30 inches in lat. 45°, in columns (3) and (5) the mean heights of the barometer as derived, with some modifications, from Munke and Dr. Golding Bird* respectively, and in columns (4) and (6) tho

* Dr. Golding Bird's Natural Philosophy, p. 208.

corresponding* corrections in feet, to be added to, or subtracted from, the altitudes derived from observations at the upper station only, by means of the tables and formulæ.

(1) Lat.	(2) Height of barometer, equal to 30in. in lat. 45°.	(3) Mean height of the barometer from Munke	(4) Correction according to Munke.	(5) Mean height of barometer from Dr. G. Bird.	(6) Correction according to Dr. G. Bird.
		in.	feet.	in.	feet.
0	30.079	29.930	— 129.8	29.930	— 129.8
10	30.074	29.935	— 121.3	29.975	— 86.5
20	30.060	29.950	— 96.8	30.064	+ 3.2
30	30.039	29.972	— 59.2	30.108	+ 59.8
40	30.014	29.999	— 13.2	30.019	+ 4.4
45	30.000	30.013	+ 11.4	30.000	0.0
50	29.986	30.027	+ 35.9	29.968	— 15.7
55	29.973	30.041	+ 60.2	29.919	— 47.4
60	29.961	30.054	+ 81.9	29.803	— 138.3
65	29.949	30.066	+ 101.8	29.609	— 299.8
70	29.940	30.076	+ 119.5	29.740	— 175.4
80	29.926	30.091	+ 143.9		

* These corrections are in some cases very different, but those in column (6) are probably in general the most trustworthy,-as best agreeing with the observations of Schouw, Sir J. Herschel, Sir James Ross, &c. See Daniell's Meteorology, (Ed. 1845) vol. I. pp. 132, 133.

TABLE I.

Argument: $\frac{t + t'}{2}$ Faht.

$\frac{t + t'}{2}$	Multiplier.	Log. A.	Diff. for 0.1	Log. C'.
10°	0.95744	4.761926	92,9	8.1188
11	95949	762855	92,6	1378
12	96154	763781	92,4	1572
13	96359	764706	92,2	1763
14	96564	765628	92,0	1956
15	96768	766549	91,8	2152
16	96973	767467	91,7	2344
17	97178	768384	91,5	2532
18	97383	769299	91,3	2725
19	97588	770212	91,1	2915
20	0.97793	4.771122	90,9	8.3105
21	97998	772031	90,7	3298
22	98203	772938	90,5	3487
23	98407	773843	90,3	3679
24	98612	774746	90,2	3866
25	98817	775648	90,0	4058
26	99022	776548	89,8	4235
27	99227	777445	89,6	4436
28	99432	778341	89,4	4625
29	99637	779235	89,2	4815
30	0.99842	4.780127	89,0	8.5001
31	1.00046	781018	88,9	5190
32	00252	781907	88,7	5378
33	00456	782793	88,5	5552
34	00662	783678	88,3	5723
35	00866	784562	88,1	5894
36	01071	785443	88,0	6065
37	01276	786323	87,8	6233
38	01481	787200	87,6	6403
39	01686	788077	87,4	6569
40	1.01891	4.788951	87,3	8.6737
41	02096	789824	87,1	6903
42	02301	790695	86,9	7079
43	02506	791564	86,7	7235
44	02711	792431	86,6	7399
45	02916	793297	86,4	7563
46	03121	794161	86,2	7726
47	03326	795023	86,1	7889
48	03531	795883	86,9	8051
49	03736	796742	85,7	8212

Table I. continued.

$\frac{\iota + \iota'}{2}$	Multiplier.	Log. A.	Diff. for 0°.1	Log C'.
50°	1.03940	4.797599	85,6	8.8373
51	04145	798455	85,4	8534
52	04350	799309	85,2	8693
53	04555	800161	85,0	8851
54	04760	801011	84,9	9009
55	04965	801860	84,7	9166
56	05170	802707	84,6	9324
57	05375	803553	84,4	9479
58	05580	804397	84,2	9635
59	05785	805239	84,1	9789
60	1.05990	4.806080	83,9	8.9943
61	06195	806919	83,8	9.0097
62	06400	807757	83,6	0250
63	06605	808593	83,4	0402
64	06810	809427	83,3	0555
65	07015	810259	83,1	0705
66	07220	811090	83,0	0856
67	07425	811920	82,8	1006
68	07630	812748	82,6	1155
69	07835	813574	82,5	1304
70	1.08040	4.814399	82,3	9.1452
71	08245	815222	82,2	1599
72	08450	816044	82,0	1747
73	08655	816864	81,9	1893
74	08860	817683	81,7	2038
75	09065	818500	81,6	2184
76	09270	819315	81,4	2328
77	09475	820129	81,3	2472
78	09680	820942	81,1	2615
79	09885	821753	81,0	2758
80	1.10090	4.822563	80,8	9.2900
81	10295	823371	80,7	3042
82	10500	824177	80,5	3183
83	10705	824982	80,4	3324
84	10910	825786	80,2	3464
85	11115	826588	80,1	3603
86	11320	827388	79.9	3742
87	11525	828187	79,8	3880
88	11730	828985	79,6	4018
89	11935	829781	79,5	4155

Table I. continued.

$\frac{t+t'}{2}$	Multiplier.	Log. A.	Diff. for 0°.1	Log. C'.
90°	1.12140	4.830576	79,3	9.4292
91	12345	831369	79,2	4428
92	12550	832161	79,0	4563
93	12755	832952	78,9	4698
94	12960	833741	78,8	4833
95	13165	834528	78,6	4968
96	13370	835314	78,5	5090
97	13575	836099	78,3	5233
98	13781	836883	78,2	5365
99	13986	837665	78,1	5497
100	1.14191	4.838446	77,9	9.5628
101	14396	839224	77,8	5760
102	14601	840002	77,6	5889
103	14806	840779	77,5	6019
104	15011	841554	77,4	6149
105	15216	842327	77,2	6278
106	15421	843100	77,1	6406
107	15626	843871	77,0	6532
108	15831	844640	76,8	6661
109	16036	845408	76,7	6787
110	1.16241	4.846175	76,5	9.6913
111	16446	846941	76,4	7039
112	16651	847705	76,3	7165
113	16856	848468	76,1	7288
114	17062	849229	76,0	7413
115	17267	849989	75,9	7537
116	17472	850748	75,8	7660
117	17677	851506	75,6	7783
118	17882	852262	75,5	7905
119	18087	853017	75,4	8026

TABLE II.

Argument—Log. C'. $\frac{a + a'}{\sqrt{B\,B'}}$

Arg.	Log. C	Arg.	Log. C	Arg.	Log. C
6.0	0.000043	7.62	0.001814	8.02	0.004572
6.1	.000055	7.63	.001856	8.03	.004679
6.2	.000069	7.64	.001900	8.04	.004788
6.3	.000087	7.65	.001944	8.05	.004900
6.4	.000109	7.66	.001990	8.06	.005015
6.5	.000137	7.67	.002036	8.07	.005133
6.6	.000173	7.68	.002084	8.08	.005253
6.7	.000218	7.69	.002132	8.09	.005376
6.8	.000274	7.70	.002182	8.10	.005502
6.9	.000345	7.71	.002233	8.11	.005631
7.0	0.000435	7.72	0.002286	8.12	0.005763
7.05	.000488	7.73	.002339	8.13	.005898
7.10	.000547	7.74	.002393	8.14	.006037
7.15	.000614	7.75	.002449	8.15	.006178
7.20	.000689	7.76	.002506	8.16	.006323
7.25	.000773	7.77	.002565	8.17	.006472
7.30	.000868	7.78	.002625	8.18	.006624
7.35	.000973	7.79	.002686	8.19	.006779
7.40	.001092	7.80	.002749	8.20	.006938
7.41	.001118	7.81	.002813	8.21	.007101
7.42	0.001144	7.82	0.002880	8.22	0.007268
7.43	.001171	7.83	.002946	8.23	.007439
7.44	.001198	7.84	.003015	8.24	.007569
7.45	.001226	7.85	.003086	8.25	.007793
7.46	.001253	7.86	.003158	8.26	.007976
7.47	.001284	7.87	.003232	8.27	.008163
7.48	.001314	7.88	.003308	8.28	.008355
7.49	.001344	7.89	.003384	8.29	.008552
7.50	.001376	7.90	.003464	8.30	.008753
7.51	.001408	7.91	.003545	8.31	.008959
7.52	0.001441	7.92	0.003627	8.32	0.009170
7.53	.001474	7.93	.003712	8.33	.009386
7.54	.001509	7.94	.003799	8.34	.009607
7.55	.001543	7.95	.003888	8.35	.009833
7.56	.001580	7.96	.003979	8.36	.010065
7.57	.001617	7.97	.004072	8.37	.010302
7.58	.001654	7.98	.004167	8.38	.010545
7.59	.001693	7.99	.004265	8.39	.010794
7.60	.001732	8.00	.004365	8.40	.011048
7.61	.001773	8.01	.004467		

TABLE III.

Argument:—Latitude, λ.

Lat. λ	Log. G. +		Lat. λ	Log. G. +	
0°	0.001142	90	23°	0.000795	67
1	001141	89	24	000764	66
2	001139	88	25	000734	65
3	001136	87	26	000704	64
4	001131	86	27	000671	63
5	001125	85	28	000638	62
6	001117	84	29	000605	61
7	001108	83	30	000571	60
8	0.001100	82	31	0.000536	59
9	001086	81	32	000500	58
10	001073	80	33	000461	57
11	001059	79	34	000427	56
12	001043	78	35	000390	55
13	001026	77	36	000353	54
14	001008	76	37	000315	53
15	000988	75	38	000276	52
16	0.000968	74	39	0.' 00237	51
17	000946	73	40	000198	50
18	000924	72	41	000159	49
19	000899	71	42	000117	48
20	000875	70	43	000080	47
21	000848	69	44	000040	46
22	000821	68°	45	000000	45°
	— Log. G.	λ Lat.		— Log. G.	λ Lat.

TABLE IV.

Argument:—Heights, h, h'.

h' / h	+ / —	h' / h	+ / —
Ft.	Ft.	Ft.	Ft.
500	0.0	11500	6.3
1000	0.0	12000	6.9
1500	0.1	12500	7.5
2000	0.2	13000	8.1
2500	0.3	13500	8.7
3000	0.4	14000	9.4
3500	0.6	14500	10.1
4000	0.8	15000	10.8
4500	1.0	15500	11.5
5000	1.2	16000	12.3
5500	1.4	16500	13.0
6000	1.7	17000	13.8
6500	2.0	17500	14.7
7000	2.3	18000	15.5
7500	2.7	18500	16.4
8000	3.1	19000	17.3
8500	3.5	19500	18.2
9000	3.9	20000	19.2
9500	4.3	20500	20.1
10000	4.8	21000	21.1
10500	5.3	21500	22.2
11000	5.8	22000	23.2

TABLE V.

Logarithms of the Barometrical Pressures in inches of Mercury corresponding to Boiling points between 176° and 215° Faht.

T.	·0	·2	·4	·6	·8	Diff. for 0°.1.
°						
176	1.145960	1.147929	1.149877	1.151833	1.153787	978
177	155740	157692	159642	161591	163539	974
178	165485	167429	169373	171314	173255	971
179	175194	177131	179068	181003	182936	967
180	184868	186799	188728	190656	192582	964
181	194508	196431	198354	200275	202194	960
182	204112	206029	207945	209859	211772	957
183	213683	215593	217502	219409	221315	953
184	223219	225122	227024	228925	230824	950
185	232721	234618	236513	238407	240299	947
186	1.242190	1.244080	1.245968	1.247855	1.249740	943
187	251625	253508	255389	257270	259148	940
188	261026	262902	264777	266651	268523	937
189	270394	272264	274132	275999	277865	933
190	279729	281592	283454	285314	287174	930
191	289031	290888	292743	294597	296450	927
192	298301	300151	302000	303847	305693	923
193	307538	309381	311224	313064	314904	920
194	316742	318580	320415	322250	324083	917
195	325915	327746	329575	331403	333230	914
196	1.335056	1.336880	1.338703	1.340525	1.342345	911
197	344165	345983	347799	349615	351429	908
198	353242	355054	356864	358673	360481	905
199	362288	364094	365898	367701	369503	901
200	371303	373102	374900	376697	378493	898
201	380287	382080	383872	385663	387452	895
202	389240	391027	392813	394597	396381	892
203	398163	399944	401723	403502	405279	889
204	407055	408830	410603	412376	414147	886
205	415917	417686	419453	421220	422985	883
206	1.424749	1.426512	1.428273	1.430034	1.431793	880
207	433551	435308	437064	438818	440571	877
208	442324	444075	445824	447573	449320	874
209	451067	452812	454556	456298	458040	871
210	459781	461520	463258	464995	466731	868
211	468465	470199	471931	473662	475392	866
212	477121	478849	480576	482301	484025	863
213	485749	487471	489191	490911	492630	860
214	494347	496064	497779	499493	501206	857

TABLE VI.

Heights corresponding to different boiling points from 176° to 215° Faht. in feet.

T.	·0	·2	·4	·6	·8	Diff for 0°1.
°	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.
176	19992	19874	19756	19637	19519	59.0
177	19401	19284	19166	19048	18931	58.9
178	18813	18696	18579	18461	18344	58.6
179	18227	18110	17993	17876	17760	58.4
180	17643	17527	17410	17294	17177	58.2
181	17061	16945	16829	16713	16597	58.0
182	16481	16366	16250	16134	16019	57.8
183	15904	15788	15673	15558	15443	57.6
184	15328	15213	15098	14983	14869	57.4
185	14754	14640	14525	14411	14297	57.2
186	14183	14069	13955	13841	13727	57.0
187	13613	13499	13386	13272	13159	56.8
188	13045	12932	12819	12706	12593	56.6
189	12480	12367	12254	12142	12029	56.4
190	11916	11804	11692	11579	11467	56.2
191	11355	11243	11131	11019	10907	56.0
192	10795	10684	10572	10460	10349	55.8
193	10238	10126	10015	9904	9793	55.6
194	9682	9571	9460	9349	9239	55.4
195	9128	9018	8907	8797	8687	55.2
196	8576	8466	8356	8246	8136	55.0
197	8026	7917	7807	7697	7588	54.8
198	7478	7369	7260	7151	7041	54.6
199	6932	6823	6714	6606	6497	54.4
200	6388	6280	6171	6063	5954	54.2
201	5846	5738	5629	5521	5413	54.0
202	5305	5197	5090	4982	4874	53.8
203	4767	4659	4552	4444	4337	53.7
204	4230	4123	4016	3909	3802	53.5
205	3695	3588	3481	3375	3268	53.3
206	3162	3055	2949	2843	2736	53.1
207	2630	2524	2418	2312	2206	52.9
208	2101	1995	1889	1784	1678	52.8
209	1573	1468	1362	1257	1152	52.6
210	1047	942	837	732	627	52.4
211	523	418	313	209	104	52.3
212	0	— 104	— 208	— 313	— 417	52.1
213	— 521	— 625	— 729	— 832	— 936	51.9
214	— 1040	— 1144	— 1247	— 1351	— 1454	51.7

Postscript.

It may be here remarked,—1. That the formulæ (10) and (11) give very approximate results only when the pressure is above half an atmosphere, but taking Regnault's value of the tension of vapour at 32° Faht., we have

$$\log p' = 1.25793 + \frac{7.426375\ (T - 32)}{422.5743 + (T - 32)},$$

which gives a maximum error of 0.025 in. at 122° Faht.

2. That the quantity a, or the fraction of saturation may be easily determined with very considerable accuracy from the formula—

$$\log a = 1 - 0.0170571\ (t - \tau) + 0.0000289866\ (t^2 - \tau^2),$$

where t is the temperature of the air reckoned in degrees Fahrenheit from freezing-point, and τ the dew point reckoned in the same manner.

3. That to the constants L and a in the general formula for the determination of heights by the barometer, and to which I have assigned the values 60369.15 feet, and 0.002039, respectively, different investigators have assigned various other values. The principal of these are as follows :—

	L, in. feet.	a, for 1° F.
Deluc, ...	58958.2	0.002242.
Schuckburgh, ...	60109.2	0.002425.
General Roy, ...	60032.4	0.002454.
Trembley, ...	60115.6	0.002462.
Ramond, and Littröw, ...	60345.6	0.002222.
Lindenau, ...	60377.7	0.002222.*
Poisson, ...	60161.8	0.002222.
Baily, ...	60158.5	0.002083.
Bessel, ...	60094.7	0.002222, or 0.002027.

* Lindenau followed Euler and Oriani in supposing the temperature of the air to diminish in harmonical progression through a series of heights increasing in arithmetical proportion. His form of the term depending upon the temperature was—

$$1 + \frac{t + t' - 64}{900} - \frac{(t - t')^2}{810{,}000},$$

t and t′ being in degrees Fahrenheit. Lindenau's Tables (Gotha 1809) were in some respects the best published in the early part of this century.

Calcutta, 19th August, 1858.

PROCEEDINGS

OF THE

ASIATIC SOCIETY OF BENGAL,

For September, 1858.

The Monthly General Meeting for September was held on the 1st instant.

Lieut.-Col. R. Strachey, Vice-President, in the chair.

The proceedings of the August Meeting were read and confirmed.

Presentations were received—

1. From the Rajah Radha Kant Deb, Bahadoor, an Appendix to his Sanscrit Encyclopædic Lexicon called the Sabda-Kulpa-Druma.

2. From Major H. L. Thuillier through Mr. Smith, a Hindu Sculpture being the image of Vishnu.

3. From Herr. H. Schlagintweit through Dr. Eatwell an explanatory table of the Relief des Monte-Rosa und Seiner Umgebungen.

Lieut.-Col. Strachey on behalf of Dr. Mouat presented to the Society a Photographic likeness of an Andaman Islander* and some Photographic pictures of the Volcano of Barren Island and of the vicinity of Port Blair.

Communications received.—

1. From E. Thomas, Esq., B. C. S., a Catalogue of the collection of coins and gems belonging to the late Col. Stacy for the purchase of which the Society is in treaty.

2. From Dr. C. A. Gordon of H. M. 10th Foot through the late Mr. Piddington an analysis of the Meteorological Observations taken on board the ship *Palmyra* during a voyage from London to Calcutta, 1857.

3. From Dr. G. Von Liebig.—

First. An account of a Cyclone in the Andaman Sea on the 9th and 10th April, 1858.

* The same man who was in Calcutta.

Second. An account of a visit to Barren Island. This paper was read to the Meeting by the Chairman.

4. From Capt. G. H. Saxton, 38th M. N. I., Cuttack, the following note on the last shock of an earthquake.

"I beg to bring to your notice, that this place was yesterday visited by a slight earthquake. As it may be thought desirable that such an event should be placed on the records of the Society, I am induced to write. The shock took place at 25 minutes past 3 o'clock in the afternoon, and was of considerable violence, sufficient to give a feeling of giddiness; it was not accompanied by any thing unusual atmospherically or otherwise. There was a slight breeze at the time, and light clouds. In the bed of the river close by, the sand rose and drifted as though the breeze was stronger there, as at this season (during the rains) it does not so readily rise. The peculiar position of the earth with reference to the sun and moon, is remarkable, the occurrence taking place about a couple of hours before a lunar eclipse. The shock lasted for a very few seconds. The vibration of a set of ricketty shelves with glasses close by where I was sitting, continued after the shock and was a very palpable evidence of the amount of violence."

The Chairman communicated to the Meeting the following information regarding a flood of the Indus.

"At 5 A. M. on the 10th August, the Indus at Attock was very low. At 7 it had risen 10 feet. By half past twelve in the afternoon it had risen 50 feet, and it continued to rise till it stood 90 feet higher than it did in the morning. The exact hour of greatest flood is not mentioned.

The Cabul river continued to flow upwards for 10 hours!

At Nowshera the whole station was entirely destroyed, excepting the public buildings which are all uninjured. But the water was several feet deep in the barracks.

The above facts are derived from a letter from the Deputy Commissioner of Peshawur.

A similar flood occurred in 1841.

There is no doubt that the present flood, like that of 1841, was caused by landslips among the mountains blocking up the river in the upper part of its course. The obstruction suddenly giving way

after a great accumulation of water had taken place produced the results mentioned.

The obstruction in 1841, was formed somewhere below Hasora. The spot was visited by the late Messrs. Winterbottom and Agnew, a year or two after the flood.

The water on that occasion is believed to have risen 800 or 900 feet above its usual level at the landslip, and the stream is said to have been stopped as far back as to Gilgit, or nearly as far.

In 1841 a Brigade or Division of the Sikh Army was encamped near Attock when the flood took place, and was swept entirely away. On the present occasion it is understood that the loss of life has not been great."

The Librarian submitted his usual monthly report for August, 1858.

Library.

The following books have been added to the Library during the month of August, 1858.

Presented.

Journal of the Indian Archipelago and Eastern Asia, Vol. II. Nos. 2 and 3, 2 copies.—By the Editor J. R. Logan, Esq.

Madras Journal of Literature and Science, January to March, 1858, Vol. III. No. 6.—By the Madras Literary Society.

Proceedings of the Academy of Natural Sciences of Philadelphia, January, 1858.—By the Academy.

Report (20th) of the Proceedings of the Calcutta School-Book Society, 1857.—By Babu Rajendralal Mittra.

Ditto (Half-yearly) of the Chamber of Commerce, 31st May, 1858, 8vo. —By the Chamber of Commerce.

Ditto (12th Annual) of the Grant Medical College, *Bombay*, Session 1857-58.—By the Govt. of Bombay.

Selections from the Records of the Government N. W. Provinces, Mr. Thomason's Despatches, Vol. II. *Calcutta*, 8vo.—By the Govt. of India.

Ditto ditto ditto Part XXXI. 2 copies.—By the Same.

Ditto ditto of the Government of Bengal, No. XXVIII.—By the Govt. of Bengal.

Vividhartha Sangraha, No. 49.—By Babu Rajendralal Mittra.

The Oriental Christian Spectator for July.—By the Editor.

The Calcutta Christian Observer for August, 1858.—By the Editor.

The Oriental Baptist for August, 1858.—By the Editor.

Erlauterungsblatt zum Relief des Monte-Rosa und Seiner Umgebungen.—By Herr. H. Schlagintweit.

Bijdragen tot de Taal-Land-En-Volkenkunde van Nederlandsch Indie, Deel I. Nos. 3 and 4.—By the Academy.

Correspondence between the British Indian Association and Government, *pamphlet.*—By the Secretary B. I. Association.

Journal of the Statistical Society of London, June, 1858, Vol. XXI. Part II.—By the Society.

Moore, (F.) Description of some new species of Lepidopterous Insects from Northern India, pamphlet.—By the Author.

——— A Monograph of the Asiatic Species of Neptis and Athyma, *pamphlet.*—By the Author.

Ratnavali an Indian Drama in Bengali, by Ramnarain Pundit, *pamphlet.* —By the Raja P. C. Sing.

——— An English Translation of the same, by M. M. S. Dutt.—By the Same.

Werken van het ke Institut voor Taal en Volkenkunde, van Nedarlandsch Indie, 2 Affeeling, *Amsterdam,* 1858, 8vo.—By the Royal Institution of Netherlands.

Exchanged.

Athenæum for May, 1858.

Annalen der Chemie und Pharmacie, April, 1858.

London, Edinburgh and Dublin Philosophical Magazine, No. 102, for June, 1858.

Purchased.

Annals and Magazine of Natural History for June, 1858, No. 6.

American Journal of Science and Art for May, 1858, No. 75.

Annales des Sciences Naturelles, Tome VIII. No. 1.

Belanger's Voyage Indes Orientelles, Parts I. to VIII.

Comptes Rendus, Nos. 19 to 22.

Dumeril's Histoire des Reptiles, Vols. 6 and 7, Parts I. II. VIII. and IX. Plates for Vols. 6, 7, 8, 9 and 10.

Deutsches Wörterbuch, Vol. II. Part 6.

Journal des Savants for April and May, 1858.

Literary Gazette, Nos. 2157 to 2160.

Prinsep's Spays, Vols. I and II, 8vo.

Revue des Deux Mondes, 15th May and 1st June, 1858.

——— de Zoologie, No. 4, 1858.

Voigt's (J. O.) Hortus Suburbans Calcuttensis, 8vo. *Calcutta*, 1845.

Wyld's Map of India.

Wustenfield die Chroniken der Stadt Mekka, Band III. *Liepzig*, 8vo.

Iconographie Zoophytologique Description par localites et terrains des Polypiers fossiles de France et Pays environnauts par H. Michelin, *Paris*, Plates.

For October, 1858.

The Monthly General Meeting for October, was held on the 1st instant.

The Hon'ble Sir James Colvile, Kt., President, in the chair.

The proceedings of the September Meeting were read and confirmed.

Presentations were received—

1. From the Government of India through Mr. Secretary Edmonstone, copy of a Persian work published by Dr. Polock the physician of the Shah of Persia, relating to the diseases prevalent in that country and their treatment.

2. From the Hon'ble the Court of Directors through the Government of Bengal, photographic drawings of the Gol Goomuz at Beejapore.

3. From Baboo Rungolal Banerjee, a copy of his Bengalee Poem Pudmini.

4. From Mr. Theobald, Junior, through Baboo Rajendra Lal Mittra, certain coins as described by the Baboo in the following note.

"My dear Gour,—Sometime ago Mr. Theobald, Junior, left with me 7 silver coins for presentation to the Asiatic Society, if I thought them worthy of its acceptance. I find the first 3 to belong to the Shah Kings of Saurashtra, No. 1 being of Vira Dama son of Dama Shah, No. 2 of Atri Dama son of Rudra Shah, and No. 3 of Bisva Shah, son of Bhathri Dama. The Society possesses no specimens of these coins and they will therefore be useful additions to its cabinet. They have been figured in the Journal and in Mr. Thomas's Indian Antiquities, Vol. II. p. 85.

Nos. 4 & 5, the last in triplicate, are very like the silver dabs found by Major Kittoe, Mr. Thomas and others in Gangetic India, and are supposed to have belonged to Hindu Kings of the 2d and 3d centuries before Christ. They bear no inscription, and their legends are indistinct. They were I understand found in Guzerat.

Yours truly,

(Sd.) Rajendra Lal Mittra.

The Council reported—

1. That the name of Baboo Roma Nauth Banerjee has been removed from the list of Members, under rule 13 of the Society's Code of Bye laws, for non-payment of arrears.

2. That they have granted the Asst. Secretary and Librarian Baboo Gourdoss Bysack leave of absence for 6 months upon urgent private affairs, and appointed Baboo Bhobany Persaud Dutt to act for him during his absence.

Confirmed.

Communications received—

1. From Baboo Radha Nauth Sikdar, an Abstract of the Meteorological Observations taken at the Surveyor General's Office in the month of May last.

2. From Mr. James Burgess, a paper on Hypsometrical Measurements by means of the Barometer and Boiling Point Thermometer. This paper gave rise to considerable discussion chiefly maintained by Colonel Strachey, Dr. Thomson and the author.

3. From Baboo Hori Sunker Dutt, Deputy Inspector of Schools, Bancoorah, through Mr. Hand, the Inspector of Schools, South Bengal, the following letter accompanied by a brick bearing a Bengal Inscription.

"I have the honor to submit for your consideration a brick which I have found in the ruins of the old temple of the *Devee Basoolee* at Chhatna in Zilla Bancoorah. This Devee is alluded to in the Poems of Chundee Doss, one of the well known bards of Bengal, and this excited my curiosity to pay a visit, on one occasion of my going to Chhatna on duty, to the scene of events now so popular with numbers of our countrymen. Here the villagers pointed out the place where Chundee Doss's dwelling stood, the stone upon which he used to sit and compose his songs, and the old site of the

temple of the Goddess to whose worship he was devoted. These no doubt had some peculiar charms, and I was still more delighted when I observed that almost all the bricks of the temple bore inscriptions which I at first could not read. I therefore looked for an entire brick, and at last found the one I now submit for your consideration.

My main object in thus intruding upon your time is to have the inscription deciphered.

I must inform you that I tried if possible to decipher it. I think I have partially made out some thing, but am very diffident as to whether my conjectures are correct.

The characters at first appear much like Deva Nagor, but I think they are old *Bengali.*

What I have been able to make out is this:—

সাঃ ছাত্না নগরেশ শ্রীযুতরবায় শক ১৪৭৫

The temple seems from this to have been built by the Rajah of Chhatna.

I have much doubt about য়

If these are old Bengali characters, I would be happy to have the other letters of the alphabet, in order that the great change which those characters have undergone during the last three hundred years, may be noticed.

I have, &c.,

(Sd.) Hori Shunker Dutt.

Baboo Gourdoss Bysack stated that the characters of the inscription were Bengalee of the period of Chaitanya Deva, and very like those of Lassen's fac simile edition of the Yajnadattabadha.

They differ from the modern Bengali in the letter র being written like ব without the dot at the bottom, and the latter being represented with a dot in the centre. This practice still obtains in Coch Behar and is not unknown in Rungpur. The letter শ্রী is very peculiarly formed and its duplication is indicated by the addition of the figure 2, and not as usual at present by the repetition of the letter itself. This mode of duplicating the *Sri* was not, however, uncommon at the time when the brick was inscribed. In some of the Nepalese coins of the 16th and 17th centuries figured by Marsden in his Numismata Orientalia, it occurs very frequently, and in a

coin of Rajrajesswari Devi the letter Sri has the figure 3 after it to indicate its triplication. The date of the inscription 1475 Saká= 1553, A. C. has been correctly read by Babu Hurrishanker Dutt, but the name of the party who dedicated the temple is not Sri Yutara. Raya as read by him, but Sri Sri Utava Raya. The reading of the Inscription is

শ্রী২ ছাতনা নগরেস শ্রী২ উতবরায় সক ১৪৭৫

or in English.

The doubly prosperous Utava Raya the owner of the doubly prosperous city Chhatana, Saka, 1475.

4. Lieut.-Col. Strachey read a memo. by Capt. H. Strachey on what is known of the proceedings and fate of Herr. Adolphe Schlagintweit.

For November, 1858.

The monthly general meeting of the Society was held on the 3rd instant.

Col. R. Strachey, Vice-President, in the chair.

The proceedings of the last meeting were read and confirmed.

Presentations were received.

1. From the Secretary of the Royal Geographical Society, the 27th vol. of the Society's Journal.

2. From the Secretary of the Ceylon Asiatic Society, part 2 of that Society's Journal.

3. From the Secretary American Academy of Arts and Sciences, Memoirs of the American Academy, New series vol. V. p. II., and vol. VI. p. I.

Letters were read.

1. From Dr. Row intimating his desire to withdraw from the Society.

Communications were received.

1. From the Government of India through Mr. Secretary Chapman forwarding for such use as the Society may think fit, a paper on

Education in China prepared by Mr. Alabaster from information communicated by Commissioner Yeh.

2. From Mr. Hall a paper on Professor Wilson's 3d edition of the Sanscrit Dictionary.

3. From Captain Tenant, Engineers. A reply to Archdeacon Pratt's recent paper on the Indian meridional arc.

4. From Major H. L. Thuillier the following extract from a letter from Captain Tenant relating to the Comet.

"As the comet now rapidly leaving us has been generally identified with the one Mr. Hind expected, (which it is not,) and has in consequence caused an unusual interest to be taken in it, perhaps the elements of its orbit will be interesting to some of your Calcutta friends.

Perihelion passage, Sept. 28th, 16h. 16m. 5.

Longitude of perihelion, 16° 36′ 4.″

Do. Ascending node, 168° 25′ 11.″

Inclination, 66° 20′ 35.″

Perihelion distance, 0.5 752,358.

Motion retrograde.

These differ totally from those of Mr. Hind's expected Comet, that of 1556.

I was unable to get any observations till the 5th October, and have only just got enough to get this orbit, but I believe this orbit will be very fairly close. I have seen no English orbit and I doubt if any has yet reached India."

The Secretary read the following extract from a note addressed to him by Archdeacon Pratt on the same subject.

"This comet is the same as that seen by Dr. Donati at Florence in June last. Mr. Hind has published one or two letters in the *Times* giving the results of his observations upon it. It is not, as was at first hoped, the 1556 or Charles Vth comet, which may yet come. From 1858 to 1861 is the range which Mr. Hind has given it.

Regarding this, or Donati's comet, Mr. Hind shews, in his letter dated September 13th, that on the 5th and 6th of October it would be near Arcturus—which you may remember we observed—and that it would pass its descending node near Venus—which also we

saw here plainly enough on the 17th or 18th of October. The motion of the comet is retrograde; for Venus is come to this side of the sun from the opposite side by the left, whereas the comet is come round by the right. The motion round the sun is consequently opposite to that of Venus and the other planets. This is fatal to its being Charles V.'s comet, if, as I believe is the case, that comet's motion was direct. No perturbations from the Planets could accouut for such a change."

5. From the Government of India through Mr. Secretary Beadon, transmitting 3 copies of a letter from the Government of the N. W. Provinces to the Secretary with the Governor General with enclosures relative to Mons. Adolphe Schlagintweit.

From Major H. Ramsay, *Commissioner of Kumaon Division, to* W. Muir, *Esquire, Secretary to Government, North Western Provinces, No.* 335, *dated Nynee Tal, the 6th September,* 1858.

Sir,—When the Messrs. Schlagiutweit left this province to prosecute their scientific inquiries in more northern countries, several Kumaon men accompanied them. Most of these men returned long ago, but Hurkishen came last of all, and after making inquiries about Adolphe Schlagintweit, he requested me to settle his accounts and receive his instruments.

2. As Captain Strachey had some knowledge of the country from which Hurkishen had returned, as also of those parts where he was to carry out further observations, I requested that officer to prepare a statement showing all that could be gathered from Hurkishen—the instruments he had received from A. Schlagintweit, and how disposed of, also the expenditure of the money he had received. Captain Strachey, at considerable trouble, has kindly prepared the enclosed memorandum with map to explain the known and probable route of the missing traveller, and I solicit the favor of your submitting it for the orders of the Right Hon'ble the Governor General.

I solicit orders regarding the pay of Hurkishen recommended by Captain Strachey, as also in reference to the collections and instruments left at different places.

MEMORANDUM.

1. Adolphe Schlagintweit crossed the Para Lasa (Pass) from Garzha (*viâ* Lahaul) of Kalla into Rapslin of Ladak, *i. e.* from India to Tibet, on the 31st of May, 1857, taking with him

1. Mahomud Amin, native of Yarkund, guide, &c.
2. Yahudi ditto, Assistant to No. 1.
3. Mahomud Hasan, of Peshawar, Moonshee, &c.
4. Abdul of Kashmir, domestic servant, &c.
5. Ghos Mahomud, of Moradabad, ditto.
6. Murli, of Bhagsu, Chuprassy, &c.
7. Moula Baksh, of Moradabad ditto, and others.

2. The first of these, Mahomud Amin, was a person of questionable antecedents, nominally a merchant trading between Yarkund and Le, but said also to have acted in the capacity of a gang-robber on the road between those places. Being at Le in 1856, he was arrested by the Dogra Thannadar Basti Ram, for debt, on the suit of sundry merchants or for other reasons, and released on the application of Herman and Robert Schlagintweit, who engaged him to act as guide for their journey towards Khotin in the summer of that year (their account of which is on record). On their return to India in the autumn, he was discharged and remained at Le, when he soon got into trouble again with the Dogra Government.

3. Some say that Agents of the Chinese Government in Yarkund having heard of his bringing European travellers across their frontier (which is high treason in their Code), offered a reward of 1,000 Rupees for his apprehension, and perhaps coerced some of the Kashmir residents at Yarkund to work upon their friends in Ladak and Kashmir for the same object, which Gulab Singh and Basti Ram possibly also turned to a mercantile transaction. However this may be, Gulab Singh having ordered his arrest and threatened to hang him soon after the Schlagintweits' departure, he fled from Ladak into Kulla, where Adolphe Schlagintweit found him at Sultanpore in April 1857. There had possibly been some previous arrangement between them. Any way Adolphe Schlagintweit again entertained him as Interpreter, Guide, and Baggage Master for another journey into Turkistan. As a specimen of his veracity, it may be mentioned that he informed deponent

(Hurkishen) that he was to have a monthly salary of 2,000 Rupees whilst travelling with A. Schlagintweit, and a monthly pension of 1,000 Rupees after he had brought him back safe to India. Major Hay, A. C. of Kulla, probably knows more of Mahomud Amin's history.

4. No. 2, name not known to deponent (Hurkishen), being commonly called "Yahudi," *i. e.* "The Jew," was a native of Yarkund and dependent of Mahomud Amin: they had some baggage poneys with them and four Turkish grooms or baggage men, all of which were engaged by A. Schlagintweit for the journey. No. 3, Mahomud Hasan, of Peshawar, was engaged by A. Schlagintweit when he was at that place in December, 1856, as a Moonshee, assisting also in scientific observations and accounts.

5. The last documentary evidence of A. Schlagintweit's movements forthcoming here, consists of a letter to Hurkishen from Changchenmo of Ladak, 14th June, a postscript to the same stating that it was not sent till the 24th idem, and one or two notes for sundry payments of money of the latter date. The letter consists chiefly of instructions to Hurkishen, and of Adolphe Schlagintweit himself, only says, "I am quite well, and at present all things seem to go on pretty right," but as it also mentions two "Dâk parcels," one for Lieutenant Charles Hall (A. C. of Bhagsa?) sent by the same despatch for transmission to Kangra. Other persons have no doubt received letters from him with particulars of his history up to that time.

6. These documents were brought from Ladak by the chuprassies Murli and Maula Baksh (Nos. 6 and 7 of the above list) who joined Hurkishen at Khardung of Garzlia on the 20th of July, 1857. It appeared from the statements of these men (made to Hurkishen) that before they left A. Schlagintweit, the Moonshee Mahomud Hasan had deserted, taking with him one of his Master's (or Mahomud Amin's) poneys, some little money, and other articles belonging to A. Schlagintweit. The chuprassies were directed to overtake him if they could, recover the property, and make it over to Hurkishen in Kullu, which they succeeded in doing, but leaving the Moonshee himself in Ladak, whence he probably made his way to Kashmir and Peshawar. He gave them a letter for his Master,

which they brought to Hurkishen and is still extant among his papers, written in pencil in broken English, excusing his sudden departure on the score of inability to endure the hardships of such a journey any longer, and admitting a balance of 72 Rupees, of which he gave the chuprassies his account, but did not pay the money. It must be observed that A. Schlagintweit makes no allusion to all this in his letters to Hurkishen; from which it may perhaps be inferred that he did not attach much importance to the Moonshee's desertion.

7. Hurkishen, when at Deyra in November, 1857, gathered from Captain Montgomery of the Trigonometrical survey and his native doctor, that they had been in Ladak during the past summer, and that A. Schlagintweit had left Le before their arrival there, and they knew nothing more of him.

8. From the locality of his last despatch, Changchenmo, (which may be seen in my map, at the N. E. end of Ladak) I infer that he crossed the Turkish water shed to the east of the Karakorum Pass, perhaps to Sugat, on the head of the Karakash River, and thence following the route taken by his brothers the year before, towards Kilian and Khoten.* It appears that he had laid in a stock of merchandize in India, with the view of facilitating his journey by trade or the appearance of it.

9. I hear of him after this through the Bhotiyas of Iwar, who got their information from Kashmiris of Ladak at the Gar fair in the autumn of 1857. It was to the effect that A. Schlagintweit had succeeded in reaching the margin of the inhabited country at the foot of the mountains; there he went out from his camp some way to reconnoitre, and in his absence the Guide, Mahomud Amin, absconded with most of the baggage and cattle towards Yarkund. A. Schlagintweit being left helpless, sent back some of the Ladak baggage-men he had brought with him with a letter or message to the Thannadar of Le, requesting him to send assistance in men, cattle, provisions, and money; whether for the purpose of continuing his attempt to penetrate into Turkistan, or merely to return to Ladak with less hardships, does not appear. When his messengers

* There is also a way through Kokrang and Dong Ailak, by which he might get into the ordinary route on this side of the Karakorum.

arrived at Le, they found Basti Ram's son in authority there, the Thannadar himself being away in Kashmir. The son is said to have refused the required assistance: more likely, in fact, he was too silly and timid to act upon his own responsibility, and referred for instructions to his father or Gulab Sigh, in Kashmir, at the expense of great delay and danger to A. Schlagintweit. The information gathered by the Iwaris at Gar goes no further, and is not very reliable even so far: indeed it is a question whether this story may not be an exaggerted mis-statement of the desertion of Mahomud Hasan in Ladak.

10. The next accounts are derived from two or three letters which have been published during the last few months in the *Delhi Gazette*, from a correspondent of that paper, apparently at Simla, and deriving his information from merchant travellers from Ladak. From these it may be gathered that Adolphe Schlagintweit passed the winter of 1857-58 at the foot of the mountains on the border of Khoten, on this side of the Chinese out-post, among the same tribe of shepherds perhaps who gave his brothers a friendly reception the year before. On his arrival there, the Provinces of Kashgar and Yarkund were in a very disturbed state from one of those invasions of the Turks from Khokund which have been recurring periodically every 10 or 20 years, during the past century.

11. On these occasions the forage invaders being joined by the Turks of the country, usually succeed in driving the Chinese Garrisons into their forts, and subverting the Celestial Government for a time, till re-inforcements come from the Chinese Provinces further east, when the rabble of Turks soon become disorganized, the Khokandis retire to their own country, and the people of Yarkund and Kashgar are left to settle their own accounts with the Chinese, which is sometimes done by wholesale massacres of the Turks of those cities. The invaders are commonly headed by one of the Khojahs of Andejan, of the family which ruled at Kashghar, before the Chinese conquest (about 100 years ago), and who still aspire to the recovery of their former dominions. An unsuccessful invasion and rebellion of the Turks, as here described, occurred when I was in Ladak in 1847-48; on the present occasion the result is said to have been the same.

12. So long as the Chinese were in the ascendant, Adolphe Schlagintweit would have little chance of penetrating the inhabited country to any distance: they have out-posts on all the roads across their frontier; from the rarity of population and traffic, individuals are easily marked; and Adolphe Schlagintweit would hardly be able to barbarize himself enough to bear scrutiny. An European traveller attempting to pass any of these out-posts would probably be stopped and turned back, and extra precautions taken against him all along the frontier, but if detected after penetrating the inhabited country to any distance, he would more probably be murdered. It is not likely that Adolphe Schlagintweit would stay more than one winter in the demi-deserts this side of Khoten, nor that if still there he would not have opened communications with Ladak and India; it is probable therefore that he took the opportunity offered by the temporary subversion of the Chinese authority to enter Khoten or Yarkund. But to go far or stay long there he could hardly avoid the notice of the insurgent Turks: the natural impulse of these people would be to rob and murder an European, but in the actual conjuncture, they might perhaps welcome him as a common enemy of the Chinese, and the mania of travel or adventure might prompt Adolphe Schlagintweit to offer himself in that capacity. In either case when the Chinese got the upper-hand again (as they are now said to have done), they would first regain possession of their southern frontier towards Ladak, and Adolphe Schlagintweit would probably retire with the invading Turks through Kashghar into Khokund.

13. The relations of the English with Khokund have been very slight, but so far as they go, wholly amicable, and on the strength of them, or of his own antecedents in Yarkund, Adolphe Schlagintweit might possibly meet a friendly reception there: on the other hand the Khokandies are (as usual with the Turks) on bad terms with all their neighbours, including the Russians, who are steadily encroaching on their North-West frontier; and this would add to his difficulties in leaving their country again.

14. The ways out of Khokund are eastward to Ili and South-Eastward to Kashghar, both completely stopped by the Chinese; Southward to Sirkol Badakshan and Cabul, but physically and

politically this would be most difficult; South-West to Samarkund and Bukhara, and Westward to Khiva, both countries probably hostile to Khokund, and certainly so to the British; an European, and especially an English traveller, would find safety there only from *Russian* protection; lastly to the Russian out-posts on the North-West and North, Fort Aralsk near the Aral and Ak-Musjed on the Sir (Jaxartes): once there, he would be in the civilized world again, under a friendly Government, and if he ever re-appears, I think it is most likely to be this way, which would lead him to Europe and not back to India. It would be futile to discuss the chances of his ultimate escape: they hang merely on the caprices of the vilest barbarians of Central Asia.

15. To return to India: some time in May 1857, before Adolphe Schlagintweit left Garzha, he detached a party consisting of

1. Ramchunder, of Lahore, Collector and Observer.
2. Gulab Sing, of Mandi, Draftsman and Assistant to No. 1.
3. „ „ Compassy.
4. „ „ Ditto.
5. „ „ Gardener and Botanical Collector.
6. „ of the Sultanpore Thannah, Chuprassy.

These under No. 1 were sent from Khardong down the Chaundra Bhogah by Kishtwar into Kashmir, with orders to turn up at Jhelum and there wait for Adolphe Schlagintweit himself or his further orders; as before mentioned they met the surveyors under Captain Montgomery in Kashmir, and this is the last, deponent has heard of them.

16. On his departure from Garzha, Adolphe Schlagintweit also left 7 Nagina, of the Sultanpore Thannah, chuprassy, in charge of collections and manuscripts deposited in the Assistant Commissioner's house at Khurdong.

This man was afterwards joined by 8 Moula Baksh, No. 7 of the first list, one of the two chuprassies who returned from Ladak in the end of July, and after taking on letters to Sultanpore (as already mentioned) brought back money (200 Rupees) for expenses at Khardong. Nos. 7 & 8 were ordered to remain at Khardong till receipt of further orders from Adolphe Schlagintweit and to take

care of his collections there till they could be sent down to Kaugra after the rains. Deponent knows nothing more of them.

17. The 3rd party consisted of

9. Hurkissen Tewari, of Almorah, Native Doctor, Observer, and Collector.

10.	Krishna	„	ditto,	Assistant to No. 9.
11.	Panchum	„	Paori,	Compassy.
12.	Magna	„	Kullu,	ditto.
13.	Sirtaj	„	ditto,	ditto.

The first of whom No. 9 is the person from whom most of this information is derived. They parted from Adolphe Schlagiutweit when he crossed the Para Lassa into Tibet, on the 31st May, 1857. During the month of June, they were employed in travelling, making observations and collections down the Bhagga valley by Shigri and Kaksan back to Khardong, where they remained till the return of the two Chuprassies from Ladak, 20th July. In pursuance of the instructions then received, they proceeded by Koksar and Shigri again, across the Kulzun-La into S. Pite, where they were joined in August by 14 Murh, No. 6, of the first list, who after leaving the despatches from Ladak at Sultanpore, brought back a supply of money (500 Rupees). The party then continued their journey through Haugrang and Kundur, up the Baspa valley across the Rupin Pass into Rawain, and thence to Deyra, arriving 11th October. Hurkishen hearing a bad account of the road across the Rupin, sent the Chuprassy Umrli, with the pouey recovered from the run-away Moonshee Mahomud Husan, round by lower Bischr, in spite of which the animal died on the road at Rampore, as certified by a letter from the Raja of that ilk.

18. Hurkishen's instructions were to go on to Futtehgurh, and expect Adolphe Schlagiutweit there by the end of October, but the disturbed state of the country in that direction rendering this impossible, he remained at Deyrah, making observations, repairing instruments, and expecting letters from Adolphe Schlagiutweit till the 12th of December. Getting no news of his master, he then deposited his collections in the Surveyor General's Office, discharged some of his Establishment (Nos. 12, 13, and 14), and proceeded

to Paoree, 25th December, 1857, and Almora, 1st January, 1858, in hopes of there getting some information or instructions.

He remained in Kumaon, making many fruitless inquiries, till the 18th February, and then returned to Paoree 2nd, and Deyra 17th March, 1858.

Finding no news of Adolphe Schlagintweit, he then left the rest of his collections and some broken instruments in the Surveyor's Office, dismissed the rest of his Establishment (Nos. 10 and 11), brought his observations and collections to an end, and returned to his home at Almorah, in April 1858.

In he wrote for information, about Adolphe Schlagintweit to the Chief Commissioner's Office in the Punjab, and the answer of the Secretary, dated Lahore, the 1858, states that they can give him none.

19. 1*st.*—Hurkishen left in Gorgha in July, 1857,

2 cases of collections, containing

with the Reverend A. W. Heyde, a German Missionary settled at Kyelang (near Khardong.)

2*nd.*—In the Surveyor General's Office at Deyra, in December, 1857,

7 cases of Geological Specimens, *viz.*, 3 Rocks and Fossils.
2 Earth and Sand.
2 Water.
1 Ditto Botanical ditto „ Plants.
1 „ Zoological „ Birds.
in all, 9 cases and about a cart load.

3*rd.*—Instruments ..... 1 Barometer, broken.
1 Thermometer ditto.

4*th.*—Ditto ..... 1 Tent.
1 Boring-tool.
1 Hammer.

5*th.*—He has got with him at Almorah
Instruments ..... 1 Barometer, damaged.
2 Prismatic compasses.
1 Pocket ditto.
1 Strike and dip compass, German.

1 Thermometer.
1 Ditto broken.
1 Ditto ground.
2 Ditto dry and wet bulb.
1 Measuring glass.
1 Ditto rod.
3 Ditto tapes.
1 Sundial.
1 Watch.
1 Magnifying glass.
Papers .... 2 Sheets of map.
5 Books of observations and references of collections.
1 Ditto accounts.
1 Ditto ditto, Persian, of Mahomed Hossein.
Peshawri, and other papers.

6th.—One case of Surgical instruments (received from the Almorah Dispensary).

2 Compasses Tripods.
1 Hammer.
1 Gun and bullet Mould.
2 „ „ „ Bags.
1 Inkstand, &c.
1 Chuprass.

20. The observations appear to have been regularly kept, according to Schlagintweit's instructions, from Para-Lassa 31st May, to Paoree 25th December, 1857, and again in a fragmentary way between Paoree and Deyra from 2nd to 17th March, 1858.

21. I have examined Hurkishen's accounts and find them regularly kept. He received an advance of 400 Rupees from A. Schlagintweit on the 31st May, and 500 Rupees by order on Sultanpore, cashed in August 1857, together 900 Rupees, the whole of which seems to have been fairly expended and duly accounted for. This covers Hurkishen's own pay at 30 Rupees per month, up to the end of December, 1857. Hurkishen himself states that A. Schlagintweit promised him a further payment of 25 Rupees per month,

making his salary up to 55 Rupees, if, on the winding up of his affairs, his work should be found satisfactory; but there is no allusion to such a promise in any of the documents produced by Hurkishen, and one of them distinctly states his pay to have been *raised to* 30 *Rupees*, from the 1st of May, 1857, Hurkishen himself admitting that it was only 25 before that. I should myself consider 30 Rupees as adequate to the style of his work. Since the beginning of January, 1858, Hurkishen has done next to nothing in the way of observation or collection, and has been for a large part of the time at his own home; on the other hand, he has been put to some inconvenience and kept out of other employment. For this I think that a sum of one hundred Rupees (100) would be a fair remuneration. There also remains due ten Rupees (10) to the Assistant Krishua, No. 10 of the 2nd list, for wages from 1st December 1857, to 5th January, 1858, at nine Rupees per month, and ten Rupees (10) to Compassy Punchum, No. 11 of the same, for wages for March and April, 1858, at five Rupees per month.

22. I am of opinion that if Adolphe Schlagintweit does not return to India, or at least to Ladak, within the next three months, his return this way should be no longer expected; that any of his establishments still extant should be finally discharged, and their accounts closed, and that all collections, manuscripts, and *graduated* instruments should be got together, sealed, packed, and sent to England, to be kept at the London Custom House unopened till called for by his brothers Herman and Robert (from Berlin*), who should be at the same time advised to make arrangements for receiving them. This is the best way of recovering some value from what has cost the Government much money, of furthering the interests of science, and doing justice to the Schlagintweits themselves. I think that *all graduated instruments whatever* should be sent home, because the final reductions of many observations depend upon the correction of instrumental errors which are sometimes ascertainable only by a *subsequent* reference to the instruments themselves, some useless things may be included thus, but in the absence of the Schlagintweits, it is safer to make the rule absolute and send all.

* Behrew. Strasse No.

23. It would be very desirable to have all the collections repack-

ed for transmission to England, as the original packing may in many cases be insufficient, but as this would involve much risk of displacing labels, &c., (which might impair the scientific value of specimens) it should be done only by the individuals who collected them, if forthcoming; by any other hands, the packing should be confined as much as possible to the cases themselves, and avoid any turning over of the contents. Every thing should be completely closed in soldered tin-plates.

24. With this view, I recommend that the instruments and papers specified in list No. 5, be taken from Hurkishen, sealed, packed, and deposited in the Commissioner's Office at Almorah, against further orders, and himself and two men then dismissed after payment of the 120 Rupees due to them (as shown above), the things mentioned in list No. 6 (of very little value) being disposed of as the Commissioners may direct. It is a question whether after this Hurkishen should not be sent to Deyrah, to repack the collections which he left in the Surveyor's Office there, being remunerated for the job by a further payment of 50 Rupees or so. Colonel Waugh might be consulted on this point.

25. I am further of opinion, that Government should call upon some of their officers in the Punjaub, to report any information they may be able to get about Adolphe Schlagintweit, and to take measures, such as suggested above, for the preservation of any collections, manuscripts, and instruments that may come within their reach, the whole of which things should be sent after the rains to the Secretary to Government at Allahabad, who could make further arrangements for their transmission to England in one batch. The parties best to be consulted are—

The Deputy Commissioner at Kangra.
His Assistant in Kullu.
The Deputy Commissioner at Simla.
Any Government Agent in Kashmir or Ladak.
The Surveyor General at Deyrah.
His Assistants in Cashmir and Ladak.
The Reverend A. W. Heyde, German Missionary at Kyelang, in Lahaul of Kullu.
Maharaja Ranbir Sing of Kashmir, and Billah Sah, his Collector of customs in Ladak.

26. If Nasir Khan, native of Bajour, domiciled at Guzerat, and trader between Turkistan and India, be forthcoming in Ladak, he would be about the best man to entrust with any further inquiries in Turkistan itself; but if any such commission were given to him, it should be quite privately. I gather from the *Delhi Gazette*, that this person passed from India into Ladak a month or two ago, with the intention, no doubt, of going on to Yarkund.

(Signed) Henry Strachey, *Captain*,
66*th Goorkah Regiment.*

Almorah, 20*th August*, 1858.

P. S.—Since writing the above, I have met with the following in the *Bombay Standard* of the 17th July, 1858: "By letters from Simla of the 3rd instant, we learn that an expedition was about to be organized under Lord William Hay, to ascertain, if possible, the fate of Herr Adolphe Von Schlagintweit."

(Signed) Henry Strachey, *Captain*,
66*th Goorkah Regiment.*

Delhi Gazette, June, 1858.

No. 1.—News has been received of Mr. Schlagintweit, who is said to have passed his winter at a place called Askilung, about five marches on this side of Yarkund, and near Aktak. It is possible that the Government is wide awake, and that Mr. Schlagintweit was deputed to that part of the world by competent authority, and that he is duly protected; if this be not the case, the news of his safety should be regarded with great caution, and the persons who have brought the news should be very closely questioned. The news has come from Leh *viâ* Zautkar, and the secrecy of Government may be so great that the same parties may have conveyed letters from Mr. Schlagintweit himself.

Delhi Gazette, July 10, 1858.

No. 2.—News from Yarkund has been received by us from a friend, upon whose information we can entirely rely, he says—"The passes from Ladak are open, and news has been received that the army of Kathai (China) engaged the force sent from Indijan (Kohkan) and defeated them, causing them to return to their own country.

From the present meagre account, the encounter does not seem to have been very bloody, in fact it seemed to be more an arrangement between themselves.

Messengers of distinction have been passing from the Shassan Court to Yarkund, holding secret conferences with the Thannadar at Leh, the meaning of which did not transpire. I am sorry to tell you that no news whatever has been received of Mr. Schlagintweit or the man Mahomed Amin who conducted him to that country. The news formerly being, that Mr. Schlagintweit had identified himself with the Indijan party, which party has been conquered by the Chinese, would place him in an awkward position, and as he would have been unable to pass the Chinese posts to return to Leh, he would have, of necessity, been obliged to retire with the beaten army towards Kohkan."

Delhi Gazette, July 17, 1858.

No. 3.—A merchant named Nasir Khan, came to Hindoostan about two years ago nominally on a pilgrimage to Mecca, where he proceeded. He returned at the beginning of the hot weather to Sultanpore in Kulu, where he took up his residence, some of his people joining him from Bombay, and others *viâ* Calcutta. He has remained several months in Kulu, and was narrowly watched by Major Hay, who was of opinion that he had other motives than those of trade.

Being anxious apparently to return to Yarkund, and wishing to know the exact state of that country, he paid a man 15 Rupees to proceed to Ladak before the passes were considered fairly opened. About a fortnight ago, this messenger brought him a letter informing him that the Chinese force had driven back the troops of Indijan, which attacked Yarkund last year when they were ill prepared for resistance; nor are the Chinese of Yarkund allowed to assemble troops without orders from Pekin. However, the important portion of my story as regards Runbeer Singh is to come. This letter stated that 200 of the rebel sepoys fully armed had been allowed to pass through the Kashmir territory, and had actually arrived in Yarkund!! Nasir Khan is a Patthan, and communicated this to the Native Officer of the guard of the detachment of the Police corps now stationed at Sultanpore.

Who can tell what is going on up there ? I met a few days ago two Mahomedans who had arrived from Leh in 19 days, just to cross the Sutledge to Rampoor. One a Kashmiri told me, that Mr. Schlagintweit was alive, and that he had gone on to Kashgar, with Mahomud Amin, the native who accompanied him from Kulu. If true, this is a curious move for him to make, and the Chinese would certainly never allow him to return the way he went to Yarkund.

(True copies)

(Signed) W. H. Lowe,

Offg. Assistt. Secy. to Govt., North-Western Provinces.

Mr. H. Blanford read a paper on the Cretaceous rocks of Southern India.

The Officiating Librarian submitted a report of the additions made to the Library during the months of September and October last.

Library.

The Library has received the following accessions during the months of September and October, 1858.

Presented.

Catalogue of the Government Central Museum, Madras, 4 Parts.—By the Madras Government.

Appendix to the Report on the Government Central Museum, Madras, 8vo., Madras, 1858.—By the Same.

The White Yajur Veda, Part 3, Nos. 4 and 5.—By Albrecht Weber, Berlin.

The Oriental Christian Spectator, Nos. 8 and 9, for August and September 1858.—By the Editor.

Indische Alterthumskunde for 1857-58.—By Charles Lassen.

Abhandlungen für die Kunde des Morgenlandes, Band 1, No. 3, 2 copies.—By the Royal Academy of Sciences, Berlin.

The Oriental Baptist for September.—By the Editor.

The Calcutta Christian Observer for September.—By the Editors.

Reports on the Harbour of Beitkul in Sedishaghur Bay, by Col. Cotton and Lieut. Taylor.—By the Madras Government.

Reports on the direct and indirect effects of the Godavery Annicut in Rajahmundry, and the Coleroon Annicut in Tanjore.—By the Same.

Selections No. 2, from the Public Correspondence, &c. of the British Indian Association.—By the Society.

The Annals of Indian Administration, edited by Meredith Townsend.—By the Home Government.

Selections from the Records of the Madras Govt., No. 2 of 1854, No. 39, and No. 45 of 1856, 2 copies and No. 49 of 1858.—By the Madras Government.

The Oriental Baptist for October.—By the Editor.

The Quarterly Review, Vols. 50-51-52.—By Babu Gourdoss Bysack.

Memoirs of the American Academy of Arts and Sciences, Vol. V. Part 2, and Vol. VI. Part 1.—By the American Academy.

General Report on the Administration of British India. and

Maps on the Administration Report.—By the Home Government.

Proceedings of the Royal Geographical Society of London, Vol. II. No. 3.—By the Society.

Journal of the Royal Geographical Society, Vol. XXVII.—By the Society.

Photographic Drawings of the Gol Goomuz at Beejapore.—From the Hon'ble the Court of Directors through the Govt. of Bengal.

Proceedings of the Academy of Natural Sciences of Philadelphia.—By the Academy.

The Calcutta Christian Observer for October, 1858.—By the Editors.

Catalogues of the Government Central Museum in Madras, British Shells, 1. Iron Ores, 1. Palaeontology, 1. Descriptive Geology, 1. Mineralogy, 1. Five Pamphlets.—By the Madras Government.

Catalogue of Books in the Library of the Government Central Museum, Madras.—By the Same.

Reports on the Government Central Museum, Madras, and on the Government Museums at Bellary, &c. Iron Ores, Manufacture of Iron and Steel and the Coals, 1. Report for 1853.—By the Same.

Report on the Woods of Madras, 1.—By the Same.

Thirty-fifth Annual Report of the Royal Asiatic Society of Great Britain and Ireland for 1858.—By the Society.

Notice of Mr. Hugh Miller, Philadelphia, 1857.—By the American. Philosophical Society.

Le Tresor des Belles Paroles, Choix de Sentences.—Tradutes Par. P. E. Foncaux.

Bibidhartha Sangraha for Joysto.—By Babu Rajendralal Mittra.

Bijdragen Tot de Taal land-en Volkenkunde van Nedarlandsh Indie, No. 2, New Series, 8vo.—By the Royal Society of Sciences, Netherlands.

The Precepts of Jesus, &c. compiled by the late Rajah Rammohun Roy

by the Unitarian Society for the Propagation of the Gospel in India.—By Babu Rajendralal Mittra.

Twentieth Report of the Proceedings of the Calcutta School-Book Society for 1857.—By the Society.

Kitáb Jozabi, or Persian Work on the Diseases of Persia, by Dr. Pollock.—By the Govt. of India, Foreign Department.

Catalogue of Birds in the Museum of the East India Company, Vol. II. —By the Hon'ble the Court of Directors.

Pudmini Vopakhayan A Tale of Rajasthan in Bengali.—By Rungolal Banerjee.

Voyages d'Ibn Batoutah, Par. M. M. Defremery et Sanguinetti, Tome 4.—By the Asiatic Society of Paris.

Reports on the Districts of Midnapore and Cuttack, by H. Ricketts.—By the Bengal Government.

Calcutta Review for September, 1858.—By the Editors.

Journal Asiatique, Tome XI. No. 43, April and May, 1858.—By the Asiatic Society of Paris.

Zeitschrift der Deutschen Morgen: Gesellschaft, Band XII. Heft 2, *Liepzig*, 1858.—By the German Oriental Society.

Purchased.

Comptes Rendus, Nos. 23 and 24 of Tome 46, and Nos. 2, 3, 4 and 5 of Tome 47, 1858.

Literary Gazette, Nos. 2161 and 2162, Old Series, and Nos. 1, 2, 3 and 4 of 1858, New Series.

Vendidad Sade, Part 4.

Sanskrit and English Dictionary, Improved from Professor Wilson, by Theodore Goldstücker, Vol. I. Parts 1 and 2.

Revue et Magasin de Zoologie, by Mr. F. E. Guerin-Meneville, Nos. 5 and 6 of 1858.

The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science, Supplement of No. 103, and Nos. 104 and 105 for 1858.

Notices et Extracts des Manuscrits de la Bibliotheque du Roi, Tome 16, P. 2.

Analectes sur l'Histoire et la Litterature des Arabes D'Espagne, par. Al-Makarri. Published By M. Reinhart Dozy.

Mutanubbi Carmina cum Commentario Wahidii, Edited by Fr. Dieterice, Part 1.

L Algebre D'Omar Alkhayyami.—By F. Woepcke.

Kitab-i-Yamini, translated by the Rev. James Reynolds.

Chronique de Matthieu D'Edesse, Par. E. Dulaurier.

Ibn Abd el Hakem's History of the Conquest of Spain.—By J. H. Jones.

Bibliotheca Egyptiaca.—By Dr. H. Jolowiez.

Map of Mont Rosa, shewing the Heights of its Peaks.

American Journal of Arts and Sciences for July, 1858.

Athenæum for June, 1858.

Annals and Magazine of Natural History for July, 1858, No. 7.

Annales des Sciences Naturelles, Vol. VIII. No. 2, Botanique and Nos. 4 and 5, Zoologie.

Deutsches Wörterbuch von. Jacobb Griciem und. Wilhelm Griciem, Vol. II. Part 7.

Journal des Savants for June, 1858.

Natural History Review for July, 1858, No. 3.

Revieu des Deux Mondes, for 15th June and 1st July, 1858.

Westminster Review, No. 27 for July, 1858.

Bhobanyprosad Dutt.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Fahr.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.804	29.887	29.732	0.155	84.6	95.1	76.8	18.3
2	.775	.852	.707	.145	85.7	96.8	77.0	19.8
3	.750	.833	.649	.184	87.1	99.8	77.4	22.4
4	*Sunday.*							
5	.813	.895	.737	.158	87.0	96.4	79.8	16.6
6	.806	.912	.709	.203	86.4	97.0	77.0	20.0
7	.742	.821	.662	.159	85.9	97.4	76.6	20.8
8	.780	.870	.715	.155	86.4	97.4	77.8	19.6
9	.792	.899	.699	.200	85.8	96.4	76.8	19.6
10	.705	.801	.609	.192	86.7	97.8	77.6	20.2
11	*Sunday.*							
12	.698	.773	.621	.152	85.7	93.0	79.9	13.1
13	.725	.790	.639	.151	86.4	93.6	81.0	12.6
14	.762	.836	.710	.126	86.2	93.0	81.6	11.4
15	.787	.855	.724	.131	86.1	94.2	80.6	13.6
16	.813	.882	.758	.124	85.2	93.4	79.1	14.3
17	.805	.875	.746	.129	85.9	94.1	79.4	14.7
18	*Sunday.*							
19	.768	.854	.685	.169	88.7	101.6	78.8	22.8
20	.757	.834	.690	.144	88.0	99.0	80.0	19.0
21	.789	.859	.729	.130	87.3	97.0	81.0	16.0
22	.830	.920	.766	.154	87.0	96.4	80.8	15.6
23	.762	.860	.660	.200	88.6	99.7	79.8	19.9
24	.681	.756	.566	.190	87.4	98.0	79.8	18.2
25	*Sunday.*							
26	.735	.881	.577	.304	84.5	93.0	72.6	20.4
27	.790	.867	.700	.167	82.6	91.6	72.7	18.9
28	.809	.880	.729	.151	84.4	92.2	80.0	12.2
29	.829	.909	.760	.149	85.7	93.6	79.0	14.6
30	.776	.869	.656	.213	85.6	92.6	79.7	12.9
..	....	....	....	....	...	....	....	....

The Mean height of the Barometer, as likewise the Mean Dry and Wet Bulb Thermometers are derived from the twenty-four hourly observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon. *(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	77.1	7.5	73.3	11.3	0.809	8.65	3.74	0.70
2	77.6	8.1	73.5	12.2	.814	.69	4.11	.68
3	76.9	10.2	71.8	15.3	.771	.20	5.13	.62
4	*Sunday.*							
5	75.2	11.8	69.3	17.7	.711	7.55	.74	.57
6	72.1	14.3	64.9	21.5	.615	6.55	6.51	.50
7	74.7	11.2	69.1	16.8	.706	7.52	5.35	.58
8	74.1	12.3	67.9	18.5	.679	.22	.84	.55
9	76.7	9.1	72.1	13.7	.778	8.29	4.54	.65
10	74.7	12.0	68.7	18.0	.697	7.41	5.77	.56
11	*Sunday.*							
12	78.9	6.8	75.5	10 2	.868	9.27	3.53	.72
13	79.4	7.0	75.9	10.5	.879	.36	.70	.72
14	79.3	6.9	75.8	10.4	.876	.35	.64	.72
15	78.9	7.2	75.3	10.8	.862	.19	.76	.71
16	79.2	6.0	76.2	9.0	.887	.49	.12	.75
17	79.5	6.4	76.3	9.6	.890	.50	.37	.74
18	*Sunday.*							
19	78.1	10.6	72.8	15.9	.795	8.43	5.53	.60
20	80.1	7.9	76.1	11.9	.885	9.40	4.28	.69
21	79.6	7.7	75.7	11.6	.873	.28	.13	.69
22	80.0	7.0	76.5	10.5	.896	.54	3.75	.72
23	80.0	8.6	75.7	12.9	.873	.26	4.66	.67
24	78.6	8.8	74.2	13.2	.832	8.85	.60	.66
25	*Sunday.*							
26	77.4	7.1	73.8	10.7	.822	.78	3.57	.71
27	76.0	6.6	72.7	9 9	.792	.51	.17	.73
28	78.8	5.6	76.0	8.4	.882	9.45	2.86	.77
29	78.8	6.9	75.3	10.4	.862	.21	3.59	.72
30	79.4	6.2	76.3	9.3	.890	.52	.24	.75
..	....	....	....	....	....	....	....	....

All the Hygrometrical elements are computed by the Greenwich constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Fahr.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.781	29.845	29.696	0.149	81.5	83.6	76.3	7.3
1	.771	.822	.675	.147	81.1	83.0	76.0	7.0
2	.755	.802	.667	.135	80.8	83.4	74.8	8.6
3	.748	.812	.666	.146	80.2	82.8	74.2	8.6
4	.758	.818	.681	.137	79.8	81.8	73.7	8.1
5	.771	.840	.688	.152	79.3	81.8	73.0	8.8
6	.793	.860	.701	.159	79.0	81.6	72.7	8.9
7	.814	.876	.726	.150	79.8	82.7	74.2	8 5
8	.837	.908	.749	.159	83.1	86.0	79.0	7.0
9	.848	.920	.752	.168	86.3	88.8	82.6	6.2
10	.848	.912	.747	.165	89.1	92.3	86.0	6.3
11	.835	.889	.727	.162	91.7	95.6	87.6	8.0
Noon.	.810	.867	.698	.169	93.4	98.3	90.0	8.3
1	.778	.838	.662	.176	94.8	100.0	89.0	11.0
2	.747	.816	.632	.184	95.2	101.3	84.6	16.7
3	.718	.782	.597	.185	95.3	101.6	87.7	13.9
4	.698	.766	.572	.194	94.5	101.1	88.7	12.4
5	.692	.766	.566	.200	92.5	100.0	87.6	12.4
6	.702	.774	.598	.176	89.6	94.3	85.8	8.5
7	.727	.808	.622	.186	87.1	91.4	84.2	7.2
8	.755	.817	.616	.201	84.7	88.3	72.6	15.7
9	.782	.881	.665	.216	83.5	86.0	74.0	12.0
10	.787	.887	.678	.209	82.6	84.8	73.4	11.4
11	.784	.874	.669	.205	82.0	83.7	73.6	10.1

The Mean height of the Barometer, as likewise the Mean Dry and Wet Bulb Thermometers are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon. *(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	77.1	4.4	74.9	6.6	0.851	9.15	2.16	0.81
1	76.9	4.2	74.8	6.3	.849	.15	.02	.82
2	76.7	4.1	74.6	6.2	.843	.09	1.98	.82
3	76.8	3.4	75.1	5.1	.857	.25	.63	.85
4	76.2	3.6	74.4	5.4	.838	.06	.69	.84
5	76.0	3.3	74.3	5.0	.835	.03	.56	.85
6	75.8	3.2	74.2	4.8	.832	.00	.50	.86
7	76.4	3.4	74.7	5.1	.846	.14	.61	.85
8	77.7	5.4	75.0	8.1	.854	.16	2.70	.77
9	78.4	7.9	74.4	11.9	.838	8.93	4.09	.69
10	79.2	9.9	74.2	14.9	.832	.82	5.30	.63
11	79.3	12.4	73.1	18.6	.803	.46	6.77	.56
Noon.	79.7	13.7	72.8	20.6	.795	.34	7.65	.52
1	79.6	15.2	72.0	22.8	.776	.11	8.54	.49
2	79.5	15.7	71.6	23.6	.766	.00	.84	.48
3	79.2	16.1	71.1	24.2	.753	7.88	9.01	.47
4	78.6	15.9	70.6	23.9	.741	.76	8.75	.47
5	78.3	14.2	71.2	21.3	.756	.95	7.64	.51
6	77.9	11.7	72.0	17.6	.776	8.19	6.14	.57
7	77.9	9.2	73.3	13.8	.809	.59	4.74	.64
8	77.2	7.5	73.4	11.3	.811	.67	3.75	.70
9	77.2	6.3	74.0	9.5	.827	.86	.14	.74
10	77.3	5.3	74.6	8.0	.843	9.05	2.63	.78
11	77.1	4.9	74.6	7.4	.843	.07	.40	.79

All the Hygrometrical elements are computed by the Greenwich constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	134.2	..	S.	Cloudless.
2	135.0	..	S.	Cloudless.
3	147.0	..	S.	Cloudless.
4	*Sunday.*			
5	139.0	..	S. & N. W. & E.	Cloudy till 7 A. M. cloudless till 3 P. M. Scatd. ⸝i & ⌒i afterwards.
6	137.0	..	S. & S. W.	Scatd. ⸝i till noon cloudless afterwards.
7	134.0	..	S. & W.	Cloudless.
8	141.2	..	S. & N. W.	Cloudless.
9	148.0	..	S.	Cloudless.
10	135.2	..	S.	Cloudless.
11	*Sunday.*			
12	132.0	..	S. & S. E. (high.)	Scatd. clouds till 4 A. M. cloudless till 5 P. M. Scatd. ⸝i afterwards.
13	135.0	..	S. (high.)	Cloudless till 4 A. M. Scatd. clouds afterwards.
14	..	..	S. & S. E.	Cloudless till 8 A. M. cloudy afterwards.
15	128.0	..	S.	Cloudy till 4 A. M. Scatd. ⸝i & ⌒i till 4 P. M. cloudy afterwards.
16	130.0	..	S. & S. E.	Various clouds till 8 P. M. cloudless afterwards.
17	130.5	..	S.	Cloudless till 4 P. M. cloudy till 9 P. M. cloudless afterwards.
18	*Sunday.*			
19	148.6	..	Calm & S.	Cloudless.
20	138.0	..	S.	Cloudless.
21	130.0	..	S.	Scatd. ⸌i & ⸝i till 3 P. M. cloudy afterwards.
22	132.5	..	S.	Scatd. clouds.
23	150.0	..	S.	Cloudless.
24	143.0	..	S. & S. W.	Cloudless.
25	*Sunday.*			
26	125.0	0.60	S.	Scatd. ⸝i till 6 P. M. cloudy afterwards, also raining, thundering and lightning between 8 and 10 P. M.
27	128.0	..	N. E. & S. & S. E.	Scatd. clouds.
28	125.0	0.37	S. & S. E.	Various clouds also raining between 1 and 2 P. M.
29	130 0	..	S.	Scatd. ⸌i & ⸝i till 1 P. M. cloudless afterwards.
30	130.0	..	S. (high.)	Scatd. ⸝i.

⸌i Cirri, ⸝i Cirro strati, ⌒i Cumuli, ⌒i Cumulo strati, ⸢i Nimbi, —i Strati, ⸢i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

Monthly Results.

	Inches.
Mean height of the Barometer for the month, ...	29.772
Max. height of the Barometer occurred at 9 A. M. on the 22nd, ..	29.920
Min. height of the Barometer occurred at 5 P. M. on the 24th, ..	29.566
Extreme range of the Barometer during the month, ...	0.354
Mean of the Daily Max. Pressures, ...	29.857
Ditto ditto Min. ditto, ...	29.690
Mean Daily range of the Barometer during the month, ...	0.167

	o
Mean Dry Bulb Thermometer for the month, ...	86.2
Max. Temperature occurred at 3 P. M. on the 19th, ...	101.6
Min. Temperature occurred at 8 P. M. on the 26th, ...	72.6
Extreme range of the Temperature during the month, ...	29.0
Mean of the Daily Max. Temperature, ...	95.8
Ditto ditto Min. ditto, ...	78.6
Mean Daily range of the Temperature during the month, ..	17.2

	o
Mean Wet Bulb Thermometer for the month, ...	77.8
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	8.4
Computed Mean Dew-point for the month, ...	73.6
Mean Dry Bulb Thermometer above computed mean Dew-point, ..	12.6

	Inches.
Mean Elastic force of Vapour for the month, ...	0.817

	Troy grains.
Mean Weight of Vapour for the month, ...	8.70
Additional Weight of Vapour required for complete saturation, ..	4.29
Mean degree of humidity for the month, complete saturation being unity,	0.67

	Inches.
Rained 4 days, Max. fall of rain during 24 hours, ...	0.60
Total amount of rain during the month, ...	0.97
Prevailing direction of the Wind, ...	S.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1858.

MONTHLY RESULTS.

Table showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour when any particular wind was blowing it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.			1				2		21		1						1		
1			1				2		21	1	1						1		
2			1		1	1	2		19								1		2
3			1		1		2		20								1		1
4			1		1		2		18	1							1		3
5			1				2		20		1		1				1		
6			1				3		18		1		2				1		
7			1				4		17		1		2		1				
8	1		1				3		18		2				1				
9			1		1		2		18		3				1				
10			1				2		19		3				1				
11	1		1		1		1		16		4				2				
Noon.	2		1		1		1		16		4				1				
1	2				2		1		15		5	1	1						
2			1		1		3	1	16		3		2						
3	1		1		1		2		16		3		1		1				
4	3								18		3		1		1				
5	1		1						18		1		2		2		1		
6			1				3		17		2		1		1		1		
7							2		21		1		1		1				
8							3	1	20	1			1		1				1
9					1	1	3		20						1				1
10					1		3		20				1		1				
11					2		2		20				1		1				